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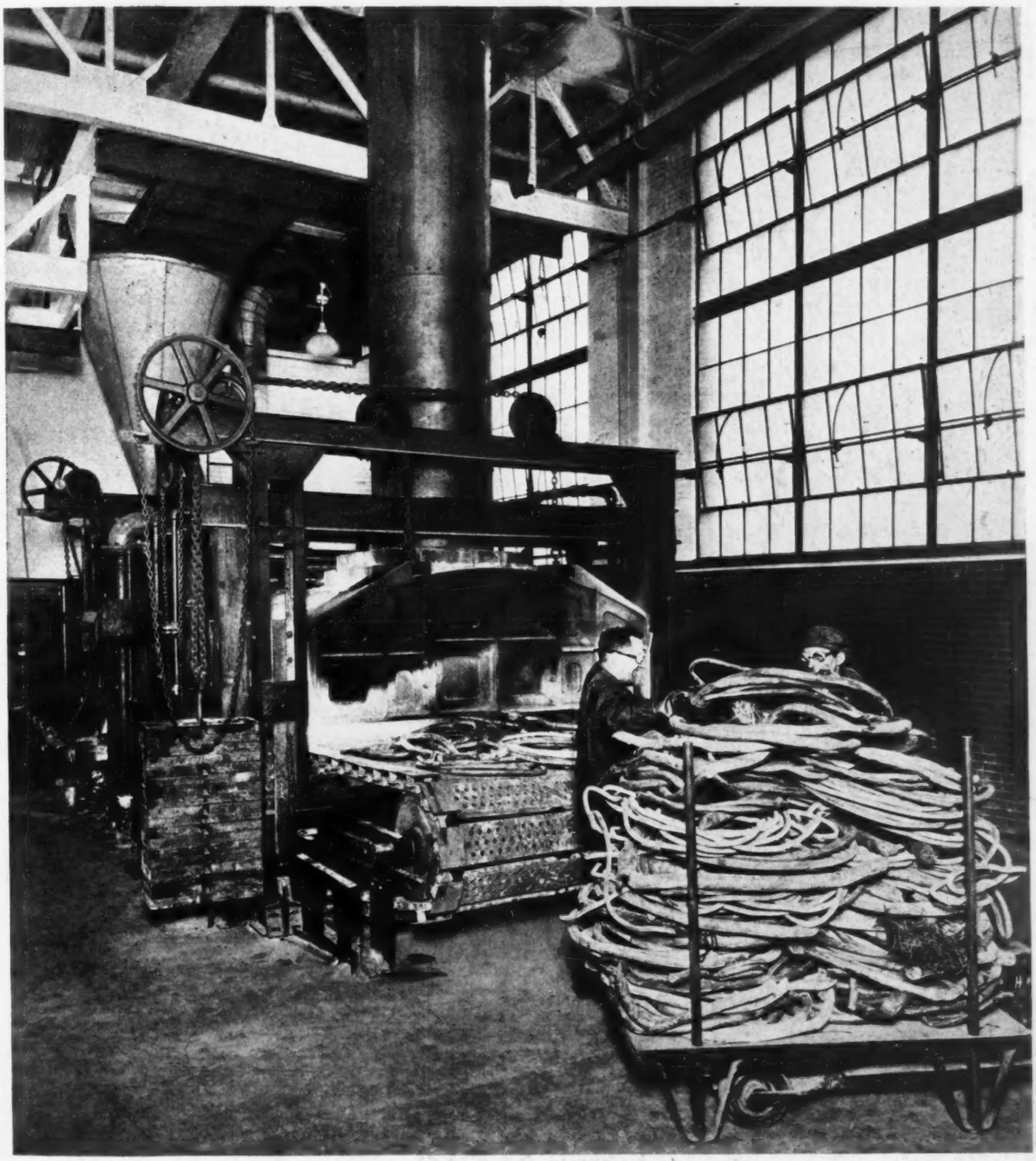

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Contents for August 23, 1930

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ENGINEERING AND
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A. W. ALLEN, *Editor*

VOLUME 130, No. 4

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Immeasurables and Intangibles in Industrial Relations

ONE of the most important aids to smooth industrial operation is a satisfactory relationship between employer and employee. Considerable progress has been made in improving conditions in such material matters as wages, housing, insurance, medical attention, education, employee stock ownership, recreational facilities, and pension systems. These phases offer the most obvious opportunity for sensible adjustment, but the basic problem goes much deeper. Few who have not actually worked and sweated at manual labor, who have not lived and dwelt among the directed rather than among the directors, appreciate the mental attitude of at least one type of laborer, representing a large proportion of the whole, who thinks rationally but who remains disappointed. Few are better qualified than is the author of "What's on the Worker's Mind" to portray and explain an unrest that is not visible even to the average welfare official. The experiences of Mr. Whiting Williams, as a laborer in Europe and in the Americas, his keen sense of perception and analysis, his qualities as a writer, qualify him as one of the foremost industrial counselors of the day, and industry will do well to heed what he says when he brings a message.

This he has done in a recent address before the Taylor Society, in which he stresses the importance of those immeasurable and intangible factors that are too often neglected in a study of industrial relations. One cause for delayed adjustment Mr. Williams sees in an over-reliance on formulæ, which indicates to him that "management is still inclined to believe that industrial relations do not require the same high type of skill and technique, based on study and experience, as is required for solving the more mechanical managerial problems." The vice-president in charge of operations, though willing to admit the increasing importance of the human factor in the operation of the plant, is still inclined to give the matter "left-handed attention and left-handed skill." He has never taken time to investigate the fundamentals of his human problem. Mr. Williams' experience has convinced him that few organizations care a rap whether or no the employee is contented at his work. The impression gained was that the task was being done because starvation was the only alternative. "And all the time, I believe," adds Mr. Williams, "we workers were all but praying that not less but more might be asked of us."

This is an indictment against management, the major excuse for which is preoccupation with other and "more important" affairs. The rift is being widened as merger succeeds merger, causing what Mr. Williams refers to as "dangerous insulations" between the directing officers and the bulk of the employees. To aggravate conditions caused by this insulation, the "yes man," or "prestige pirate," or "credit hog" has arisen, any one of whom is in a position to "substitute his opinions and prejudices for not only those facts and figures which represent the company's measurables, but also for those various individual viewpoints, interests, and desires which represent its fundamental and final human resources."

The truth must be faced that the large organization, on which industry is being patterned, must meet spiritual as well as material obligations and responsibilities. It should concern itself with intangibles as well as with tangibles when planning its industrial relations program. Its high executives will fail in duty and performance if only the excuse of preoccupation can be offered to explain why matters of vital import to harmony, happiness, and efficiency are left to subordinates who do not realize the tremendous influence of their actions or inactions.

Increased Demand for Ammonia in Metallurgy

USE of ammonia in leaching dates back to about fifteen years ago, when Mr. C. H. Benedict, of Calumet & Hecla, developed a successful process for the extraction of copper from tailing. Later an ammonia process was adopted by Kennecott, and recently it has also found application in the metallurgy of zinc. Commercial plants are now in operation in which zinc oxide is being leached with ammonia.

Those who first conceived the idea of using ammonia for large-scale leaching operations possessed great courage, for at that time ammonia was one of the expensive chemicals, and its volatile properties necessitated careful design of equipment to minimize loss by evaporation. The manufacture of ammonia by synthesis, however, has greatly reduced its cost, so that today it ranks among the cheapest bases on the market, considering comparative alkaline content. Great improvements have also been made in handling and transportation. Formerly a thirty per cent aqueous solution was the highest concentration available. Today, liquefied anhydrous ammonia is shipped in closed, insulated tank cars, built to withstand high pressure, which are transported over long distances in perfect safety. A great saving in freight is thereby accomplished, and the anhydrous ammonia may conveniently be diluted to any desired concentration by the consumer. Liquefied ammonia has also

been found suitable for use without dilution, thereby taking advantage of properties in some respects differing from those of dilute ammonia.

Ammonia has been found to possess valuable properties as an addition agent in the flotation process. It may be used to replace lime, and as a reagent to promote selective action. Although it has not been generally applied in this field, indications point to a wider use. Other opportunities are being developed. Manufacturers of superphosphate are finding that ammoniation gives a better product and is economically preferable to the alternative methods of neutralizing excess acid. Because of its easy handling and transportation, liquefied ammonia may also be used as a source of hydrogen. It can be converted into the gaseous form at a uniform pressure, and it has the added advantage of being nonexplosive. Experiments are being conducted to use it in the atomic hydrogen welding process, where the neutral atmosphere created by the liberated inactive nitrogen promises to be of advantage.

Catalytic oxidation of ammonia has proved so efficient that it is replacing the older methods of manufacturing nitric acid. This comparatively simple procedure has reduced the cost of nitric acid—formerly considered too expensive for general use in leaching processes—to a level having interesting economic significance. The hydrometallurgist is now in a position to consider the wider use, on a larger scale, of two valuable solvents, one an alkali, the other an acid, the price of each of which is being reduced in conformity with improved technology and increased output in the chemical industry.

Faster Hoisting from Shallow Depths

THE rapid advance made in recent years in the automatic control of hoisting operations is not appreciated to an extent deserved by those who have successfully solved unusual ore-raising problems. The question as to what is the best procedure to adopt in an extremely shallow shaft can be answered by an excursion to a property in Illinois—one of the mines of the Peabody Coal Company. The depth of the shaft is but 238 feet, and the load per trip only about 3,000 pounds. A steam hoist, which used to raise 230 cars per hour, was replaced by electrical equipment, whereby the number of trips per hour can be increased to 258.

The main feature of the installation is the use of a synchronous motor, to drive the generator, without which the performance would have been impossible. Push-button control at the engine platform is used for starting and stopping the generator. Automatic contactors and auto transformers, controlled by timing and protective relays, bring the set to speed at a maximum rate of rope acceleration of nearly fifteen feet per second per second. The diameter of the drum varies from five to nine feet, with an abrupt increase allowing for only 3½ turns in the acceleration period. A breaker in the main circuit is closed when the main controller is placed at the "off" position, and the brake is applied.

This example of modernization demonstrates once again that special problems deserve special treatment. The solution usually awaits the application of experience and engineering skill, coupled with an optimism that disdains thought of failure. Hoisting records of a depth of a few hundred feet are as praiseworthy as those that refer to operations that penetrate for a mile or more below the surface of the ground. Advances made possible by the application of modern electric equipment to short-haul hoisting have not been fully realized.

Status of Engineer Licensing Unchanged Despite Opposition

MOST mining engineers seemingly are not interested in the proposal made that they join with other branches of the engineering profession in an effort to control the engineer licensing movement. At least, the sentiment expressed by some members of the profession appears to be against the inclusion of mining men in any licensing scheme. Undoubtedly, the average mining engineer dislikes anything that savors of restriction on his freedom. Adverse criticism of licensing therefore pleases him. But he should perceive that mere opposition without action is futile.

A more hopeless task can scarcely be conceived than attempting to defeat the movement to license engineers. In the legislatures of the various states the representatives who favor licensing in some form or other far outnumber those opposing it. To the former and to the great majority of their constituents it seems eminently right and fair that the engineer who builds, or wishes to build, a bridge, a tunnel, or a structure such as a mine headframe or a concentrator, where the safety of workmen or the public may be at stake, shall first secure a license. Such a license simply means that the licensee has demonstrated his qualifications for the job to the satisfaction of an official board of examiners. The right of the public to demand that such work shall be properly performed is readily perceived. No argument is necessary to make it visible. The burden of proof is on those who deny that right.

With the engineer's dislike for the state's insistence upon licensing, where a license has not previously been required, and for the petty annoyances that may attend the securing of a license, *Engineering and Mining Journal* is in complete sympathy. A licensing law seems just another blow at the freedom of the individual. But this publication believes that mining engineers are deceiving themselves if they think that they can defeat the licensing movement by ignoring it. Far wiser would it be to join with other engineers in a collective effort to direct the movement, thereby to secure the best possible and least obnoxious laws in the several states. The public and its representatives in the various state governments can hardly be hostile to the interests of engineers. But these interests may not be served in the best possible way unless the engineering profession intelligently endeavors to educate the legislatures as to what is really needed. Under such circumstances, solidarity of the engineering profession is exceedingly desirable.

Tin Industry Faces Facts

Alfred James

RECURRENCES of booms and depressions in the tin industry are illustrated by statistics and graphs, which indicate that such recurrences are cyclic. Painstaking economic research and sound logic have been applied in suggesting a solution of the problem.

The present position of the tin-production industry prompts the publication of these notes, in the hope that they may be as serviceable to consumers and investors as they have been and still are to myself. I think the time has come for the chief consumer, the United States, to take a closer interest in production. To the second of the graphs shown herewith (Fig. 2) I have appended a warning to show what the industry might expect if producer and consumer do not, by co-operation, take effective action to level out the bumps—those peaks and gorges.

Two generations ago a compliment that he "knew tin" was almost the proudest a Cornishman could receive. In these later days interest in tin has widely extended; shrewd and world-famous financial houses look on the economic prospects of that metal as better than of any other. Not all discoveries of tin ore have proved remunerative, however. The United States has within its borders no tin mine of importance. Even Cornwall, which held premier position for so many centuries, now produces scarcely as much tin as Australia and but little more than Africa. In the Malay States, however, the Cornish have aroused the attention of the world by their sound, far-sighted, and unselfish management of the best low-cost producing mines there. The Cornish are not alone in this respect; Scotchmen and Chinese contribute materially to the output, and the introduction, by an American firm, of dredges fitted with jigs has revolutionized the industry, making profitable the working of deposits formerly held of no economic value.

This is the first of a series of articles on the economics of tin production, by a close observer of mining practice in all five continents, a past president of the Institution of Mining & Metallurgy, and an engineer well known to readers of *Engineering and Mining World*.

Tin is used in large quantity in the manufacture of tinned plate; also for solder, and for bronze, and for "weighting" silk. The government of the United States maintains a close watch on the consumption of tin in industry. Substitutes have been suggested. From Circular No. 6165, U. S. Bureau of Mines, on "Consumption of Tin in the United States During 1928," I extract the following:

"During 1928 the United States consumed 73,270 long tons of virgin or primary tin, which was approximately 7.5 per cent more than the 68,198 long tons consumed in 1927 and equaled 41 per cent of the world's production in 1928 (approximately 178,000 long tons). . . . In addition to the virgin tin accounted for above, 12,106 long tons of secondary metallic tin were used by manufacturers of tin products in 1928. . . . New uses for tin have been developed in only minor or insignificant amounts. . . . Variation in consumption from year to year parallels the fluctuations in demand for the already well established tin products. . . . Growth in the electrical and the more recently developed industries (aeroplane, refrigerators, radio, etc.), while affecting total consumption of bearing metals, solders, etc., has made little change in the proportions required for these basic methods of using tin.

"The recorded recovery of secondary tin as metallic tin shows approximately 9,000 short tons annually in the United States and 24,000 tons in tin alloys. . . . The greatest single use of secondary tin is for solder, as 4,520 long tons of secondary metal were employed for this purpose in 1928. The secondary tin used for babbitt amounted to 2,189 long tons; for bronze, 1,112 long tons; for chemicals, 1,085 long tons; for type metal, 878 long tons; and for white metal, 785 long tons."

In estimating United States requirements one must bear in mind the considerable use of recovered tin. In contrast to the tin plate, foil, and tube industries, which consume only 940 tons of reclaimed tin, as against 36,000 tons of virgin tin, solder consumes about 1 ton of secondary to 3 tons of virgin tin. Babbitt metal absorbs 1 ton of secondary to 2½ tons of virgin tin. This factor should be especially considered when reckoning the consumption of metal by the motor industry. The ever-increasing demand for tin requires a greater supply than can be obtained from the old sources. This demand can be met only by working, at increased cost, the deeper mines and lower-grade deposits. This fact should be kept in mind by producer and consumer alike.

To speculators suffering from the serious slump in price of the metal

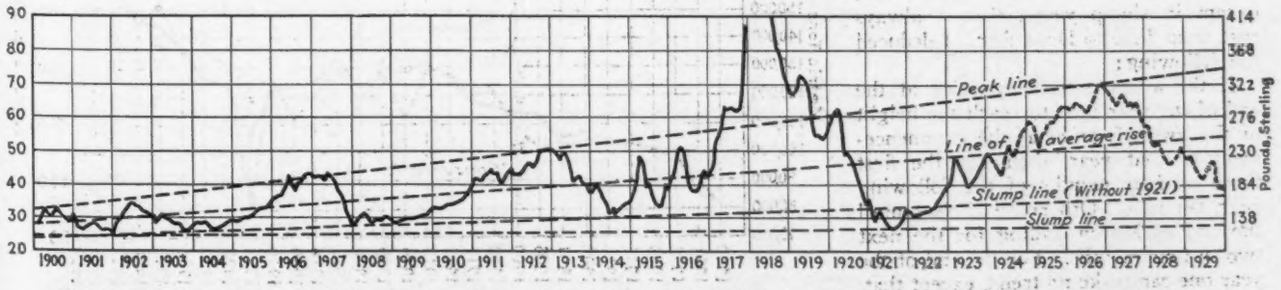


Fig. 1—Tin price chart, 1900-23, prices in cents. Taken from "Engineering and Mining Journal." Prices from 1924 on are from current quotations in England.

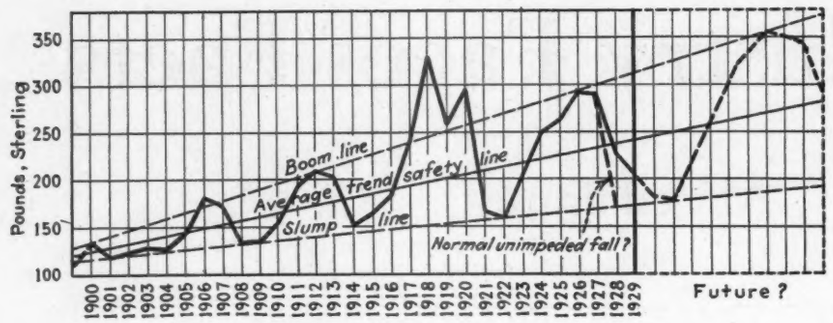


Fig. 2—Yearly averaged prices for tin, showing boom and slump prices

since 1927 my assertion of increasing cost may seem unreal; but only by the steps referred to above can the world's requirements be met. Increased world cost—as distinct from cheapened local costs—is not reflected at the moment in a steady appreciation of the price of the metal: the present low price is caused by the usual variation in production rate induced by a peak price, plus speculation following on the increase in supply. Output of the metal is comparatively so small, and the balance between supply and demand is so sensitive, that a plus or minus production of only five thousand tons may produce a boom or a slump.

If one remembers that history repeats itself, but never in the same way, and that the graph is the compounded result of all the influences affecting the tin market, it would be reasonable to expect that the future will show movements corresponding in a general way to those indicated by a graph. A major disturbing influence, such as the War, modifies such movements. It recently increased the anticipated movements both for the rise and for the fall—when the time of the latter arrived. On the other hand, a universal adoption of modernized production and distribution practices should wipe out the "Alpine slopes."

Taking the *Engineering and Mining Journal* metal-price chart issued early in 1924 (see Fig. 1), I endeavored at that time to obtain an idea of how, on a rising market, I might fix meetings with mine owners at periods of temporary decline, and thus obtain a temperament more amenable to discussion than would be possible during boom periods. I arrived at the conclusion that tin was not usually at its best in June; but, except in slump years, that it always rose from June to December. I deduced the following:

If the average monthly price at the end of the year fails to reach the height of the average price at the commencement of that year, then, for the first three or four months of the following year, tin falls. Otherwise it rises until the end of March, falling for the next two to four months. For the end of the year one can make no trend, except that, even including the slump year 1920, tin has always risen in July and August, except in 1921. It has always risen from the end of September to November, except in the slump year 1920.

Generally, with the price of tin at 75 per cent over the previous lowest point in the price curve, the slump nadir, overproduction, and consequent slump in price are again indicated, accompanied by a serious drop in consumption. With the price of the metal at only 60 per cent of that of the previous boom zenith, an increased consumption is caused, and production is overtaken, with consequent increase in price until sufficient inducement is thus offered to increase output materially. A steady rise in the price of tin has only followed an established demand by industry for metal in excess of production.

Fig. 1 is made up of a series of waves, of growing amplitude of movement as the mass increases. But all these waves—the War wave excepted—have points in common: (1) A line drawn from the price of the metal on Jan. 1, 1900, and rising at the rate of 1¼c. a year, has the peculiarity that a severe slump ensues whenever the price of tin rises to £40 per long ton above this line. This line presented early in 1925 an accurate forecast of the present slump, which, commencing in November, 1926, really got under way in April, 1927. (2) A line projected from the peak of 1900 through the peaks of 1907 and 1912-13 indicated the peak price of 1926.

Difficulty was experienced in projecting a slump line, because of the lack of conformity of the nadir (or point of lowest depression) of 1921 with the nadirs of 1914, 1908, and 1903. On consideration it seemed preferable to work on a graph based on annual averages rather than monthly averages.

From Fig. 2 are obtained boom and slump lines conforming more nearly to previous averages; and, above all, a line of averaged rise (about ¾c. per pound, or £4 per long ton per annum) showing the figure for any year, as determined by the law of supply and demand, essential for the production of tin sufficient for world requirements. This line, indicating the normal economic production price (cost plus profit) for any year, may be considered

Table I—Tin Used in the United States, 1927-28 (Umhau)

	Primary				Secondary
	1927		1928		1928,
	Long Tons	Per Cent	Long Tons	Per Cent	Long Tons
Tin plate and terne plate	24,525.00	35.96	27,052.83	36.92	860
Solder	13,602.00	19.94	13,483.00	18.44	4,520
Babbitt	7,595.00	11.14	7,851.00	10.71	2,189
Bronze	4,663.90	6.85	4,296.00	5.86	1,112
Foil	4,193.38	6.15	5,068.25	6.92	.....
Collapsible tubes	2,709.64	3.97	2,864.28	3.91	.....
Chemicals	2,620.50	3.84	4,245.87	5.79	1,085
Tin oxide	1,311.17	1.93	1,183.30	1.61	.....
Tinning, brass, copper tubes, sheets or shells, wire, nails, etc	2,661.18	3.90	2,636.08	3.60	197
White metal	848.70	1.24	801.86	1.09	785
Type metal	450.00	0.66	400.00	0.54	878
Castings	1,011.00	1.48	730.41	0.99	23
Other alloys	556.69	0.81	628.65	0.85	283
Miscellaneous	1,450.46	2.13	2,028.00	2.77	174
Totals	68,198.25	100.00	73,269.26	100.00	12,106

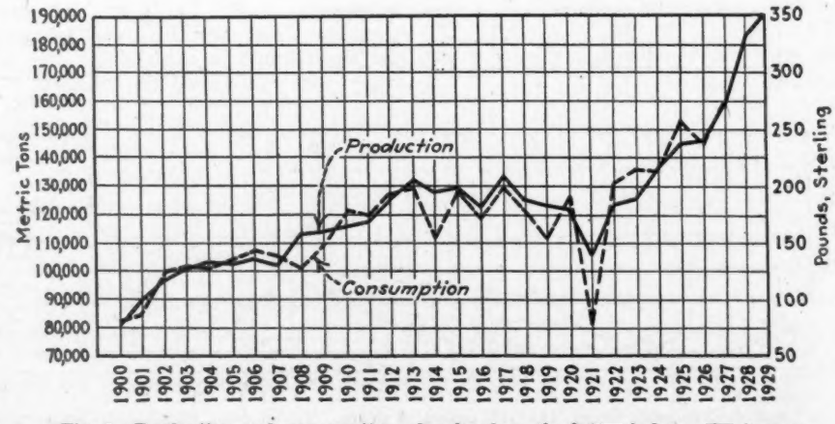


Fig. 3—Production and consumption, showing how the latter induces the former

a safety line, on which alone adequate supplies will be forthcoming. It should avoid the famines resulting from the freezing out of essential production as a result of slumps based on anticipation of great production from companies floated during a boom. I suggest that, if consumers and producers agree on a fair-price line, such as my safety line, and on production at a scale to meet the varying demands of industry, the price can be held with comparatively minor variations, dependent on industrial demands. Regular and adequate production would thus be encouraged, to the detriment of speculative and uneconomic flotations.

The average safety line shows an economic safe price for the end of 1929 of 52½c. per pound, or £242 per long ton. When the price of tin has fallen below the average line shown in Fig. 2 a famine has resulted within four or five years. The figure indicated by this line of an average rise of ¾c. per pound, or £4 per long ton per annum, compares well with observed figures. From 1901 to 1928 the average increase in price was £4 0s. 5d. per long ton.

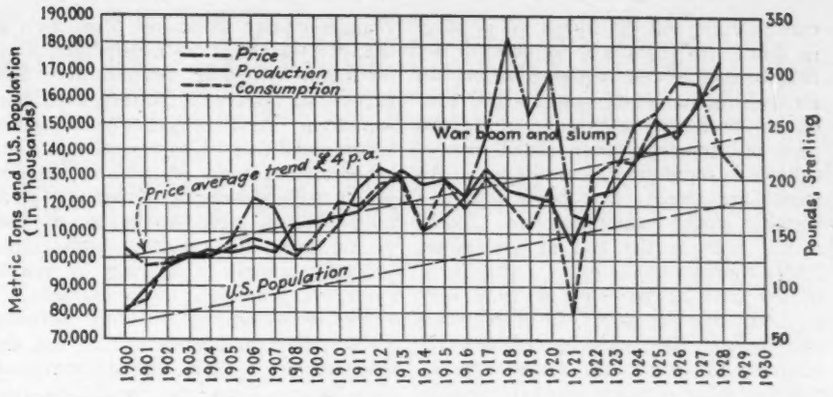


Fig. 4—Average trend chart, based on production, consumption, and price figures available at end of 1929

Table II—World Tin Output and Consumption 1900-1930

Year	Average Price £	s.	d.	Metric Tons: Smelter Output	Consumption: Actual	Consumption: N A Trend
1900	133	11	6	80,300	81,600	81,600
1901	118	12	6	89,200	84,100	84,600
1902	120	14	5	96,700	99,700	87,600
1903	127	6	5	100,500	101,600	90,600
1904	126	14	8	103,100	101,000	93,600
1905	143	1	8	102,400	104,100	96,600
1906	180	12	11	104,400	107,800	99,600
1907	172	12	9	102,400	105,200	102,600
1908	133	2	6	113,300	100,900	105,600
1909	134	15	6	113,900	109,100	108,600
1910	155	6	2	115,700	121,300	111,600
1911	192	7	0	117,900	119,700	114,600
1912	209	8	5	125,100	127,900	117,600
1913	201	13	7	132,500	129,100	120,600
1914	151	2	9	127,700	111,100	123,600
1915	164	4	0	129,600	128,100	126,600
916	182	3	5	122,500	118,400	129,600
1917	237	13	1	133,800	129,400	132,600
1918	329	11	2	125,100	121,300	135,600
1919	257	9	8	123,500	111,400	138,600
1920	296	1	7	122,000	127,000	141,600
1921	165	8	2	105,000	81,000	144,600
1922	159	10	9	123,700	131,600	147,600
1923	202	5	0	125,300	136,500	150,600
1924	248	17	4	136,400	135,900	153,600
1925	261	1	8	145,700	152,900	156,600
1926	291	3	0	146,800	145,900	159,600
1927	289	1	4	158,700	159,800	162,600
1928	227	4	8	185,100	177,000	165,600
1929	203	18	10	193,000	165,500?	168,600
1930 (Estimated)	.....			194,000	Under 160,000?	171,600

At this stage it becomes desirable to examine production and consumption, of which the *Metal Bulletin* furnished me with figures up to the end of 1927. To these I add later figures and the yearly averaged standard prices, and also a column increasing by 3,000 metric tons annually, as indicating normal averaged trend consumption at any period. A definite percentage increase on consumption would be more desirable than my averaged trend, but a glance at Table II shows the difficulty of working out such a figure. I calculate that production has averaged, from 1900 to 1928, an annual increase of 3,364½ metric tons, and that consumption has increased by 2,996½ tons.

I do not accept as actual the figure in Table II, for consumption in 1928, in which connection see articles in *Mining Journal* of Nov. 12, 1927, and July 14, 1928. The amount originally stated was 165,500 metric tons, closely agreeing with my trend figuring of 165,600. From other calculations I infer that 12,000 tons of tin were lifted off the market during 1928-29, with the idea of modifying the fall in price. This tin may have been reported as consumed instead of stocked.

In 1926 it looked as though all the accumulated balance from the production of the previous 30 years had been exhausted and industry was being maintained precariously only by hand-to-mouth supplies. But for the boom that stimulated the bumper production of 1928—over 20,000 metric tons in excess of 1927—consumption would actually have slightly exceeded production! For 1922-27, inclusive, consumption exceeded production by 26,000 metric tons!

Table II shows that a plus or minus variation in consumption of from eight to ten thousand tons occurred in 1902, 1909, 1910, 1912, 1920, 1921, 1922, 1925, and 1927, omitting the War years. The high prices of 1906-07 had, as a sequel, a lessened consumption, amounting to 6,900 tons for the years that followed. Similarly, the reaction of the high prices of 1911 and 1912 was a lessened consumption of 9,400 tons; of 1917 and 1918 a lessened consumption of 18,000 tons. The foregoing figures are actual lessened consumptions; 6,000 tons should be added to each set to make up for the averaged increase in consumption deferred until the return of cheaper prices.

Having regard to these variations in

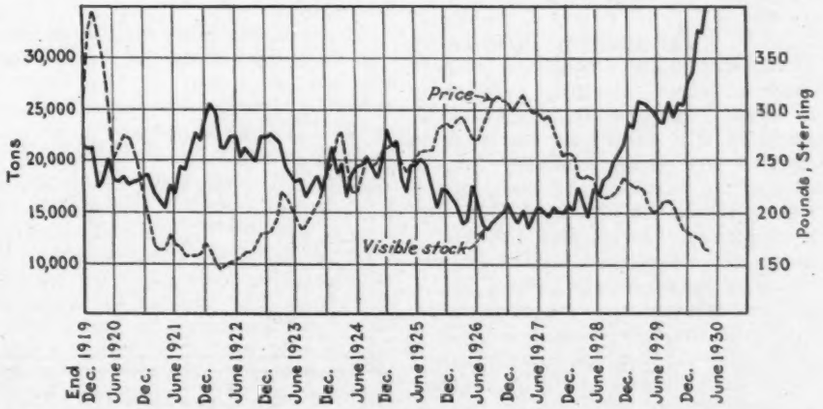


Fig. 5—Indicating reaction between visible stocks and price during development of slump and development of a boom

consumption and the indust. al position in the United States, I am basing my calculations on an actual consumption for 1930 of not more than 160,000 tons of tin, or a surplus production in the year of something over 30,000 tons—subject to regulation of production. As stocks are already far above normal—visible stocks amounted to 28,730 metric tons at the end of December, 1929—the contemplation of a surplus of 60,000 tons at the end of 1930 may frighten some producers out of existence and induce the majority of the remainder to enter into some form of agreement to produce more closely in accordance with the needs of industry.

On the other hand, the low prices of 1901-02, 1908-9, 1914, 1919, and 1921-22 induced heavy demands, which more than compensated for the consumption held up by famine prices. After the low price of 1921 there was an increased consumption of 50,600 tons in 1922. Of what avails the 8,000 or even 9,000 tons in the stores of American users against the threat of such consumption! The partial closing down of demand because of the industrial reorganization of 1921 held up an unconsumed surplus of 21,000 tons. All of this, and more, was absorbed in the years that followed.

There is evidence since 1923 of organized buying, which has not been altogether successful. In previous years the tables read clearly; but it looks as though buyers were induced by the rise in 1923 and 1924 to hold off from the market to the tune of some thousands of tons, with the result that they had to come in during 1925 and to take no less than 17,000 tons off a rising market, thus paving the way for the 1926-27 boom. Holding back again in 1926, buying 10,000 tons (7,000 plus 3,000, the average annual increase) less than requirements, they had to come in during 1927 on the top of a boom which would otherwise have collapsed earlier, and to take from the market an increase of 13,900 tons. One would imagine the industry functioning more sweetly if some responsible body maintained and controlled adequate stocks.

A study of Table II indicates that industry bounds in to purchase increased quantities every time tin slumps, and that the increased consumption thus gained for tin is never lost, not even during a famine. See the rush of purchasers in the years following the slumps 1908-09, 1913, 1919, and most notably 1921. A glance at Fig. 3 shows how consumption induces production and indeed closely follows it. If to Fig. 3 is added the price graph shown in Fig. 2, the close connection between price, consumption, and production is noted. As shown in Fig. 4, so long as consumption keeps below production, all three lines rise—War period excepted—but so soon as the higher (famine) price stimulates production so that it rises above the consumption line, forthwith a slump occurs in which everything apparently suffers, even consumption. What really forms the pulse to the condition of so sensitive a market is visible stock. As this mounts, or shows a tendency to mount, so price falls. Then after a period of low visible stock, the resulting high prices suddenly achieve a soaring of visible stock, and a collapse in the market.

Fig. 5 shows the reaction between visible stock and price during the development of a slump and the inception of a boom. Note how the anticipation of production causes a slump, but that the boom does not take place until visible stock has sunk to 15,000 tons. Development of a boom, as seen by this graph, is a much less spectacular affair than that of a slump, in which anticipation plays the major part. As will be seen from Fig. 5, the anticipation in Feburary, 1920, of an increase in visible stock (which did not materialize for two years) depressed the price of tin from £396 to £142; but prices commenced to rise so soon as the increase in visible stock was checked, and continued to do so until September, 1926-March, 1927, when anticipations of an increase in visible stock, eighteen months to two years later, led to the present slump.

A study of these graphs, coupled with the increased consumption arising during periods of low prices, leads one to anticipate the probability of a lower range for visible stock during the latter part of 1931, even though a decline in consumption results from the recent slump in the United States.

Any plan for the maintenance of a permanent stock should not come within the scope of visible stock. The latter, as we know it, is the reaction between supply and demand.

(To be continued)

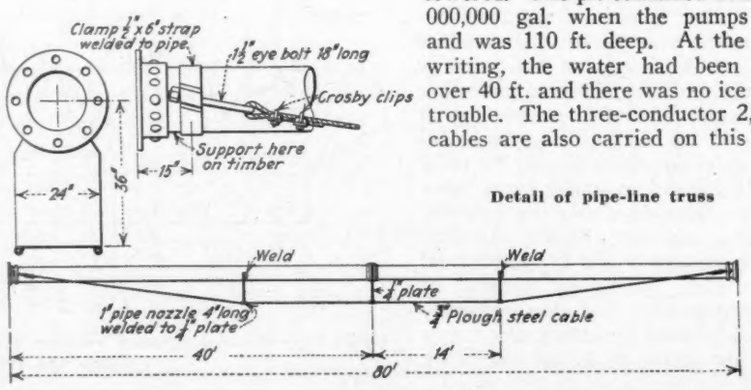
Pipe Line Truss

Pipe lines from bank to scow in winter time

IN pumping out the Canisteo mine, at Coleraine, Minn., the problem came up of supporting a section of 18-in. pipe 80 ft. long, having one end on the bank and the other on a floating scow. The pipe spanned water over 80 ft. deep and, when running full, weighed almost 5 tons. It was 14-gage spiral-riveted pipe with standard flanges. The truss used was built as illustrated.

The part requiring closest attention was the tension on the ¾-in. plough-steel cables. Take-up bolts at the end had to be tightened until there was a bow upward of about 3 in. from the center line, so that, when the line was full of water, the added weight stretched the cables until the pipe was straight.

The illustration shows the two spans in operation when the weather was 30 deg. below zero. Around the scows, each of which contains a 7,000-g.p.m. Allis-Chalmers pump, the ice is cut so the scow floats free and is able to swing toward shore as the water in the pit is lowered. The pit contained over 2,500,000,000 gal. when the pumps started and was 110 ft. deep. At the time of writing, the water had been lowered over 40 ft. and there was no ice to cause trouble. The three-conductor 2,300-volt cables are also carried on this truss.



Detail of pipe-line truss

Electrolytic Restoration of Metals

To archaeologists throughout the world, the Fink and Eldridge process for restoring ancient bronzes and alloys has been of inestimable value. Formerly, the only methods of treatment available were cleaning processes. If an *objet d'art* were severely corroded, its restoration was therefore impossible. By the Fink and Eldridge process, however, a reversal of natural corrosion is accomplished by electrolysis. Each mineral of corrosion is reduced to its respective metal, and, what is especially remarkable, these metals are deposited, atom for atom, in their original positions. Inasmuch as the minerals of corrosion are identical with the same minerals as they occur in nature, a knowledge of the circumstances surrounding their conversion to metal by means of the Fink and Eldridge process is helpful in explaining the origin of ore deposits of the minerals.

H. D. Keiser

Assistant Editor

RECENT progress made by Dr. Colin G. Fink, head of the division of electrochemistry, Columbia University, in developing his electrolytic process for the restoration of ancient bronzes and other alloys, indicates that the process may provide the geologist with a new source of information concerning ore genesis, in addition to being of increased value to the archaeologist and society in general by revealing much of the art of the ancients that otherwise would remain obscure. So striking, in fact, are the results that have lately been achieved with the Fink process, and so far reaching may be its applications in the future, that an estimate of its probable value is impossible.

Briefly, the recent advances made in the process by Dr. Fink enable him to restore to its original metallic form, including surface inscriptions or markings, an ancient bronze or alloy that has been *completely corroded or mineralized;* that is, one in which none of the original metal remains as metal. Heretofore, ancient metallic *objets d'art* that had reached such a condition were hopelessly beyond restoration. Now, by means of the Fink and Eldridge process, which is a reduction rather than a cleaning process, they are revealed in all their original beauty just as the artist of old conceived and executed them.

The principle on which the success of the process depends is that, in the corroded object, the details of the original are reproduced, although generally in unrecognizable form, in the crust that surrounds or entirely replaces the original metal, and that, during the growth or building up of this crust, the movement of the metallic constituents is, at any point, normal to the neutral axis of the original object at that point, and the distance of movement directly proportional to the original distance from that axis.

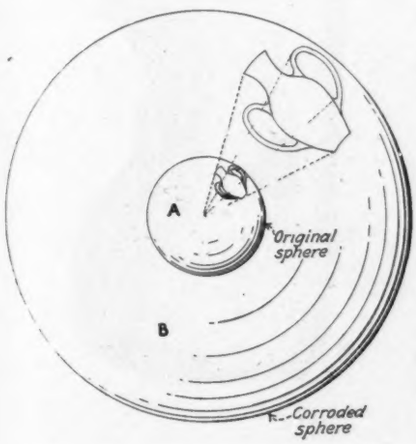


Fig. 1—Corrosion of a spherical bronze object

Many of the ancient bronzes are vases or bowls, the contours of which correspond to those of a sphere. Therefore, to illustrate the aforesaid principle in the simplest manner, the free mineralization of a spherical bronze object may be considered. For instance, if *A* in Fig. 1 represents a bronze sphere that has been suspended by a fine thread in a gaseous medium until it has corroded to the size represented by *B*, the design shown on sphere *A* would be enlarged to the size of that shown on sphere *B*. The process of corrosion may be visualized better, perhaps, if it be likened to the inflation of a child's rubber balloon from a partially inflated diameter to a diameter three or four times as great. Transition of the original bronze to basic copper carbonate and tin oxide corresponds to the inflation of the balloon; whereas, restoration would correspond to its deflation.

Further illustration of the principle is shown by Fig. 2, wherein the outline of the original bronze is indicated by the broken lines *ab* and *cd*, and that of the corroded object by the solid lines *AB* and *CD*. In the course of corrosion, every point in the original outline moves outward, and the ultimate distance traveled by an outer point, such as *E* or *F*, is proportional to its distance from the axis *XY*. In other words, every point or metal atom in the outer surface, *AB* and *CD*, is situated at a distance from the axis that is proportional to the distance of that same point or metal atom from the axis before corrosion started.

In the application of the process, a 2 per cent solution of caustic soda is used as an electrolyte. The object, without any preliminary cleaning, is hung as a cathode in the solution, and a low-amperage direct current is applied. Soft copper wires are used to suspend the object, which is completely immersed in the solution. If the object is exceptionally soft and fragile or is completely mineralized, one to two turns per inch of fine annealed copper wire are wrapped around it, and electrical connections are made with several turns of this wire. Moreover, if the condition of the object is such that removal of the hard supporting shell may

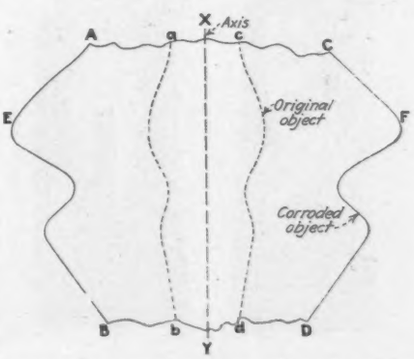


Fig. 2—Corrosion of a section of a vase

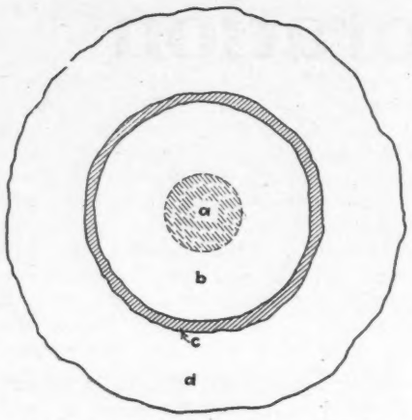


Fig. 3—Cross-section of a corroded copper-silver alloy bracelet

cause it to fall apart, the entire object, after electrical connections are made, is packed in clean white sand and the containers are filled with the caustic soda solution.

The anodes, which are made of iron, lead, or platinum, are hung on two opposite sides of the object. A rectangular glass battery jar of one-liter capacity is used as a container for the treatment of small bronzes; stoneware tanks or tanks made of heavy sheet iron, with welded joints, are employed for large objects. For a small object of about 2 to 10 sq.in. of exposed surface, the cell is connected in series with a rheostat; a direct current of 110 volts is then so applied as to send a current of from 0.1 to 0.5 amp., through the circuit. Hydrogen is evolved at the cathode, and the basic copper carbonate and tin oxide of a corroded bronze, for instance, are reduced to copper and tin, respectively, by the removal of carbonic acid, water, and oxygen. Complete reduction is indicated by a free evolution of gas at the cathode, with comparatively low current values. The object is then removed from the solution and carefully washed in warm water.

In the process of corroding, the copper of a bronze changes to cuprite and then, in turn, to malachite. Complete mineralization of ancient metallic objects has evidently required centuries. Restoration is, in comparison, a rapid process, even though the period required to restore a completely mineralized object may exceed four years.

Fig. 4—Statuette of Isis, before and after treatment

Fig. 5—Enlarged cross-section of an old Roman bronze ring

To effect satisfactory restoration, the original object must have had full freedom to corrode; otherwise, its true shape will not be preserved in the crust of corroded material. For instance, a bronze that has rested for centuries between two blocks of stone, with which it has been in contact, could not be restored to its true dimensions, inasmuch as corrosion would have been restricted by the blocks. The striking results achieved with the process are well illustrated in Fig. 4, which shows a small Egyptian bronze, a statuette of Isis, before and after treatment. This object, which bore only a thin layer of corroded material, was restored in 21 days.

From a geological standpoint, the process is important in that it may reveal the character of the origin of various mineral deposits. This follows from the fact that malachite and the other minerals that comprise the products of corrosion of ancient bronzes and alloys can be converted by the process to their original metallic form. Similar treatment, therefore, of specimens from natural occurrences of these mineral should disclose whether the deposits are disintegration products of their respective metals. Furthermore, the chemistry of corrosion of ancient metallic objects aids in explaining some of the characteristics of certain ore deposits, such as, for instance, the stableness of the copper sulphate and atacamite deposits in Chile, and the fact that these deposits are underlain by primary sulphides. Also, the circumstances surrounding the formation of native silver in nature undoubtedly resemble those associated with the formation of the layer of pure silver that is found in the corroded copper-silver alloys.

In Fig. 3, which is a cross-section of a corroded copper-silver alloy bracelet, the inner portion, *a*, represents the original bracelet; this area may contain either a core of the original copper-silver alloy or may consist entirely of oxides of the metals, if mineralization has been complete. Beyond this area is a band, *b*, of malachite; then, peculiarly, a narrow ring, *c*, of pure silver; and finally a surrounding layer, *d*, of malachite, containing included clay. But, what is more peculiar than the formation of the pure silver ring outside the original surface of the bracelet, is the fact that the surface detail or markings of the original bracelet are reproduced on the outer surface of the pure silver ring. The decuprification of the alloy, resulting in the formation of the silver ring, is comparable to the dezincification that occurs in the corrosion of brass boiler tubes.

In the accompanying enlarged views and photomicrographs are shown details of two corroded ancient bronzes and typical sections of corroded and uncorroded bronzes. The cross-section of an old Roman bronze ring is shown at a magnification of six diameters in

Fig. 6—Enlarged cross-section of a handle from a Grecian bowl

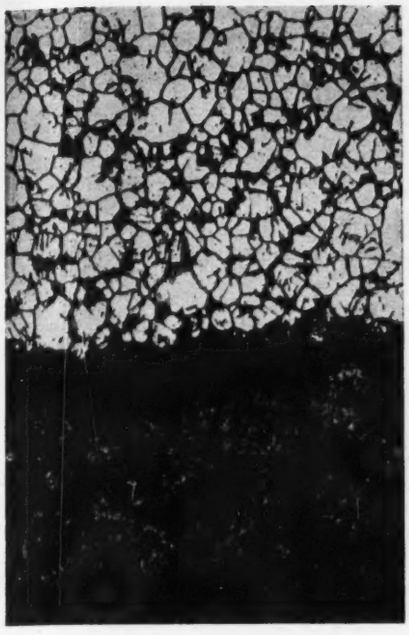


Fig. 7—Photomicrograph of a portion of the handle shown in Fig. 6

Fig. 5. The outer layers of malachite are clearly discernible, and the partially corroded interior is seen within these layers. Fig. 6 shows an enlargement, at a magnification of six diameters, of the cross-section of a handle from a Grecian bowl. The dark spot in the center is a hole, but above and below this spot are areas, outlined by a faint dark line, that consist of uncorroded, original bronze. Beyond these areas is a slightly darker area that is composed of metal and oxides. Surrounding this is a band, about 2 mm. wide, that is composed of red oxide of copper. Then comes a narrower band, wherein cuprous oxide is in the process of transition into malachite, and, finally, are seen the outer layers of malachite. This handle illustrates particularly well the value of the Fink and Eldridge process. If former acid-cleaning methods were used to restore the object, only the inner metal core, devoid of any details of design, would be recovered; whereas, by means of the process, the entire handle, with inscriptions and markings, could be restored to its original form.

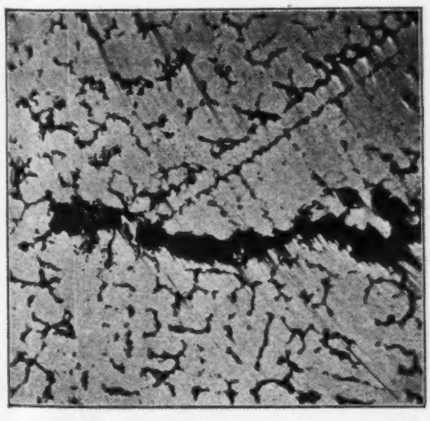


Fig. 8—Photomicrograph of corroded bronze

Fig. 7 is a photomicrograph, at a magnification of 100 diameters, of the handle shown in Fig. 6. The view was taken at the contact of the residual metal core with the surrounding area, which is composed largely of metal and cuprous oxide. Metal crystals, with corrosion proceeding between the intercrystalline boundaries, are seen in the lighter portion of the view. A photomicrograph of corroded bronze is shown in Fig. 8; the black band is an intrusion of malachite. For comparative purposes, a photomicrograph of normal cast bronze (gun metal), at a magnification of 100 diameters, is shown in Fig. 9, and, in Fig. 10, a photomicrograph of modern bronze (90 per cent copper, 10 per cent tin).

Following the aforesaid description, the importance of the Fink process to the archaeologist is readily understood.

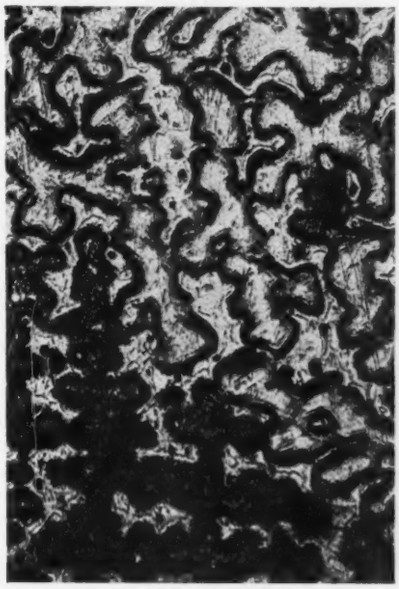


Fig. 9—Photomicrograph of cast bronze

One application employed by the director of an American archaeological expedition operating in Greece might, however, be cited here. In this instance, excavations were made through many feet of atmospheric dust that had accumulated during the centuries. Completely mineralized bronze and silver coins, in such a corroded condition that they could scarcely be recognized, were found at various elevations as excavating proceeded. These elevations and the individual coins found at each elevation were recorded, and, when the coins were restored by means of the Fink process, the dates on the coins disclosed the year or years in which the ruins and objects, unearthed at the respective elevations, were originally constructed. A chronological record of ancient operations could therefore be established. Certainly, such contributions to ancient history may be largely attributed to the achievements of science.

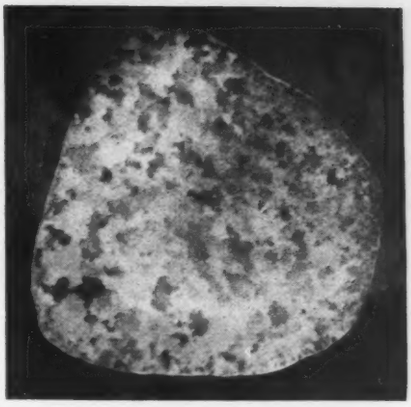


Fig. 10—Photomicrograph of modern bronze

Referring to the process of corrosion and the preservation of ancient metallic objects, Dr. Fink states in a recent publication[1]:

"The corrosion of metals is today generally recognized as being due to electrochemical action. This action requires, first of all, the presence of water on the surface of the metal; but the amount of water required is usually very minute. Pure water alone acts extremely slowly, but invariably, on the surface of ancient metal objects of art —as well as on the surface of modern creations—we find appreciable quantities of salts and acids. These, combined with the water or moisture, form 'electrolytic solutions' which greatly accelerate the corrosion or destruction of the metal. Finally, the oxygen and carbonic acid of the air play a very important rôle in corrosion. Minerals are more permanent than metals, and nature strives untiringly to convert back to mineral the metal that man has so diligently won from its native compound.

"Yet, withal, in the absence of water or moisture, mineralization or corrosion of metal objects is practically non-existent. Thus we can easily account for the splendid condition in which the metal treasures of the dry tombs of Egypt were found. Similarly, metal objects of the early South American races have been wonderfully well preserved in the dry, arid regions of northern Chile.

"Bearing this important fact in mind, it will at once be appreciated why we have for years recommended a dry, 'arid' atmosphere inside the glass cases in which metal objects are put on exhibition. . . . To create a dry, acid-free atmosphere we place in inconspicuous parts of the case small porcelain dishes containing caustic soda and lime."

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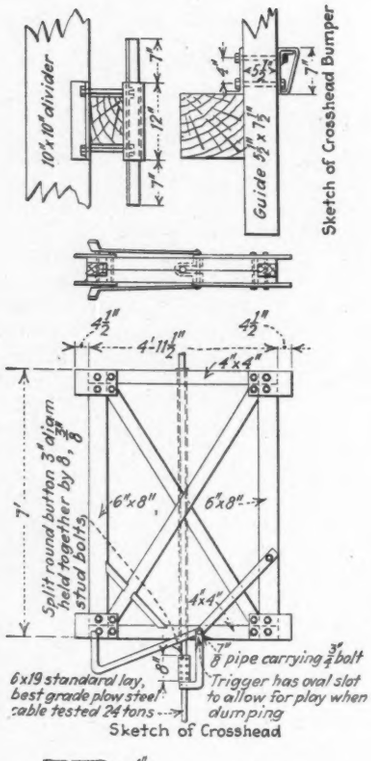
[1]"Modern Methods for the Preservation of Ancient Metal Objects," by Colin G. Fink, Metropolitan Museum Studies, Vol. II, Part 2, May, 1930.

Shaft-Sinking Practice at Copper Mountain

D. L. Sawyer

Assistant mining engineer, Granby Consolidated Mining, Smelting & Power Company, Copper Mountain, B. C., Canada



Shaft crosshead and accessories

THE Copper Mountain mine, Allenby plant, of the Granby Company is in the Similkameen Mining Division of Western British Columbia, about 12 miles south of the town of Princeton. The shaft-sinking practice here to be described embodies standard eastern Ontario and Michigan methods. At the Copper Mountain property the work was carried on under the supervision of J. A. McLaughlin, mine superintendent; N. E. Nelson, mine engineer; B. G. Anderson, assistant mine superintendent; and Fred W. Denton, Jr., shaft foreman.

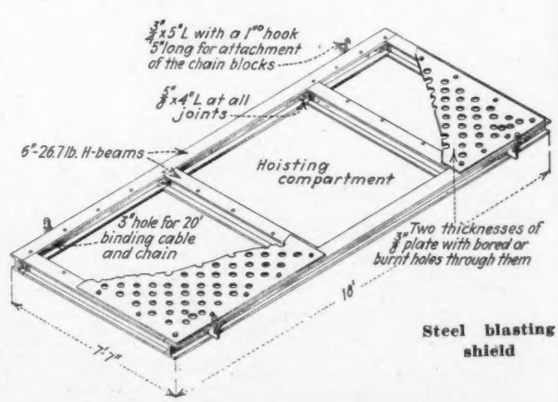
The shaft was sunk from the Level 5 to below Level 8, a depth of 750 ft. It has three compartments, two 6x6 ft. inside, for hoisting, and one 3x6 ft. for ladders and pipes. Ten-by-ten inch timbers are used, the framing details of which are shown herewith. The distance between sets may be changed underground by cutting longer or shorter timbers for posts, which are not framed, if the ground encountered in sinking makes such change necessary. The rock in which the shaft was sunk is a gabbro, of moderate hardness, which drills and breaks well, and stands well enough to allow the bottom to be carried 25 or 30 ft. below the timbers. However, because of the fractured nature of the rock, 75 per cent overbreaks were not uncommon, and the average overbreak was much larger than had been anticipated.

Three shifts were employed, the crew on each consisting of one boss, one hoist man, one deck man (or bucket dumper), one trammer, and seven miners. The shaft foreman built up his crews from local, inexperienced men, no shaft men being available in the district.

After a round has been blasted and the gas has been cleaned out, which requires about an hour, four men are lowered in the bucket slowly. They clean down loose muck from the timbers, blow off the blasting set with an air hose, let down the 50-ft. chain ladder to the bottom, and spray the muck pile with water. When the muck is nearly out (when they are picking bottom), two men go up to the blasting set and lower down the six drilling bobs for for spotting the holes. After all the rock has been shoveled, the bottom is blown absolutely clean with air, and the final cleanup (which has been blown toward the center) is shoveled into the bucket. This is done to facilitate drilling the holes and finding missed holes or bootlegs with powder in them. While this final cleanup is being made, the header (an illustration of which is presented herewith) is prepared for lowering, and the six line oilers are filled. A double block at the collar assists in handling the header. The header is hung on the ring at the bottom of the bucket. All the hoses are bunched together and tied with a rope, and then steadied before being lowered. On signal the bunch is lowered to where the men just above the blasting set can reach the 3-in. hose and connect it on the 4-in. shaft airpipe. A second set of double blocks is then used to fasten and maintain the header at the desired height. Valves on the header end and on the machine end of each air hose are each fitted with a Denver-Gardner line oiler and two Gilman connections.

The six C.P. jackhammers (Nos. 5 and 6) and part of the steel are sent down. Then the machines are connected, and drilling is commenced. The drilling of the 18-hole center "V" cut round is so divided that three men are assigned to each half, and each man has three holes to drill. The two extra men assist in pulling steel, serving the bucket, and bailing.

When the bottom is wet, 2¼-in. starters are used and 14-in. lengths of 2-in.

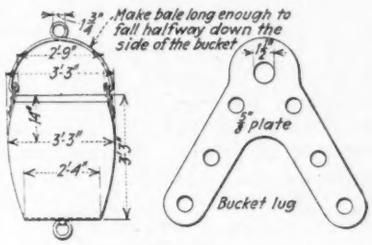

⅜"x5"L with a 1" hook 5" long for attachment of the chain blocks
⅜"x4"L at all joints
6"-26.7 lb. H-beams
Hoisting compartment
5" hole for 20' binding cable and chain
Two thicknesses of ⅜" plate with bored or burnt holes through them
18'
7'-7"

Steel blasting shield

pipe are driven into the collars of each hole to stop the dribbling of fine muck into the hole. The cut holes are drilled 8 ft. deep, which makes a small sump in the center of the shaft. When a hole is drilled it is plugged with a wooden plug. As soon as a driller has finished his holes he blows them out and replugs them.

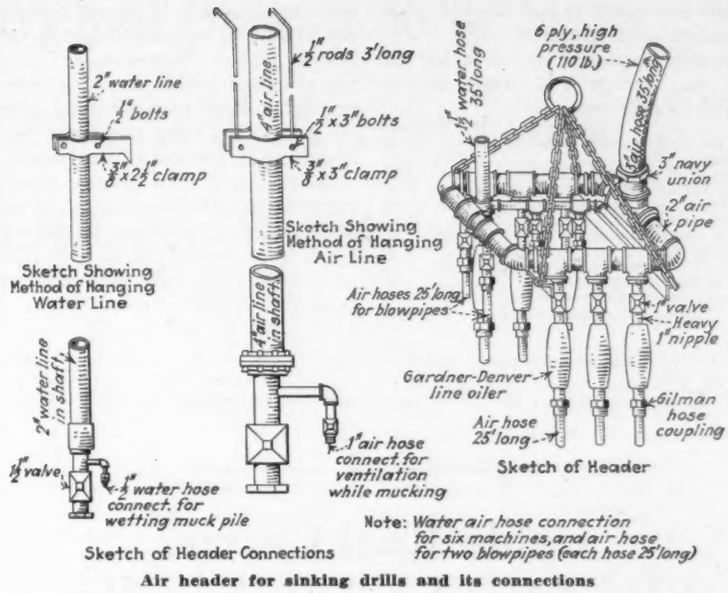
When all the holes are drilled, and the drilling equipment has been sent up, the header is sent up. During this time part of the men are loading the holes. Two of them, who have disconnected the header, pull up the drilling bobs. No. 8 delay electric blasting caps and Nos. 1, 2, 3, 4, 5, 6, and 7 delays are used. Zero delay is not used, as it is considered too fast, is harder on the timbers, and likely to interfere with the ignition of the other detonators.

After all the holes are loaded, four men go on top and the two men on the blasting set lower the lead wires to the two men at the bottom, who have been connecting the wires to the different holes. The holes are connected in series because of insufficient electrical current to connect in parallel, although the parallel connection is to be preferred. The occurrence of missed holes is very rare. Connections all being made, the men at the bottom give the bell signal for turning off the air on top and then open the 3-in. air valve. When all the holes are connected and tested with a Du Pont galvanometer, the two men in the bottom go up about 50 ft. and connect the two 18-gage copper lead wires, covered with contrasting colored insulation, to the main 220 a.c. 60-cycle wires. These main wires are carried down the shaft on insulators from the locked blasting switch above.



Sinking bucket and lug

When all the men are out of the shaft the boss unlocks the blasting switch, closes it, and holds it closed until he hears the first report. After the round is fired, the 3-in. air valve is opened above and the blower is started. The air valve is not opened until the round is fired, so as not to interfere with the wiring of the holes. On the air line near the collar is a gage which indicates whether the valve on the air line at the bottom of the shaft has been left open and proper ventilation is being obtained. The blower is a Connersville, 10 cu.ft. per revolution, exhausting from a point about 25 ft. above the blasting set, through a 12-in. galvanized iron pipe. About one hour is required to clear the shaft sufficiently of powder gas to permit resumption of work. An average round breaks about 130 buckets (20 cu.ft. per bucket) of rock and requires 11.6 hours on the average to muck out.


2" water line
1/2" bolts
3/8" x 2 1/2" clamp
Sketch Showing Method of Hanging Water Line
1" rods 3' long
1" air line
1/2" x 3" bolts
3/8" x 3" clamp
Sketch Showing Method of Hanging Air Line
2" water line in shaft
1/2" valve
1/2" water hose connect. for wetting muck pile
Sketch of Header Connections
1" air line in shaft
1" air hose connect. for ventilation while mucking
1 1/2" water hose 35' long
6 ply, high pressure (110 lb.)
Air hose 35' long
3" navy union
2" air pipe
Air hoses 25' long for blowpipes
1" valve
Heavy 1" nipple
Gardner-Denver line oiler
Gilman hose coupling
Air hose 25' long
Sketch of Header
Note: Water air hose connection for six machines, and air hose for two blowpipes (each hose 25' long)

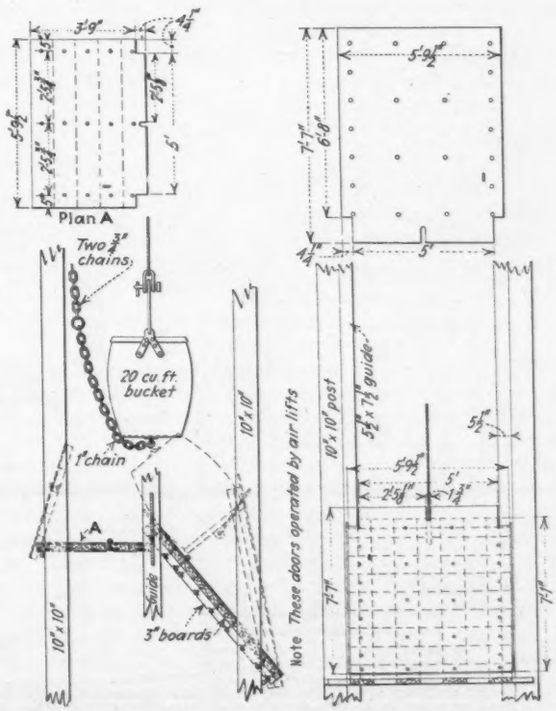
Air header for sinking drills and its connections

The blasting set (shown by the accompanying illustration) is fastened to the set of timbers next to the bottom set by four 20-ft. pieces of $\frac{5}{8}$-in. steel cable and $\frac{3}{8}$-in. chain. It is also secured by four chain blocks. These are 1½-ton, screw-geared, Yale and Towne, 32-ft. lift, chain blocks. Each block is in turn fastened to a set above with an 8-ft. length of $\frac{5}{8}$-in. chain.

When it is desired to place timbers, the blasting set is lowered 10 ft., and two wall plates are lowered onto it and then hung on the hanger bolts. Two more wall plates are lowered onto the blasting set. Then the two end plates are placed on the two hanging-wall plates, the eight posts and dividers set in position and the six $\frac{3}{4}$-in. hanging rods tightened. The four timbering bobs are hung on blocks so that their strings hang exactly 1 in. from each inner side of the timbers at the corners. When the corners of the set are in position and blocked tight, the blocks opposite the end of the dividers are placed and tightened. On completion of this set the blasting set is lowered a few feet and another timber set is placed.

As a safety precaution, and for convenience while timbering, planks are placed over the hoisting compartment of the blasting set and are held in place by ½-in. bolts placed through the planks and through the holes in the plates.

When a level station is reached, hitches for the bearers are cut and the bearers are placed loosely in them. Then the station set with 18-ft. posts is hung as are the regular shaft sets, except that $\frac{7}{8}$-in. hanger rods are used. The bearers are clamped to the bottom of the dividers and the end plates, and are



Shaft doors used in dumping bucket

brought into position and blocked when the station set is plumbed.

The time consumed in advancing the shaft one average 6-ft. round is distributed as follows:

	Hours
Cleaning and barring down	1.2
Mucking	11.6
Picking and cleaning bottom	1.1
Setting up and drilling off	4.9
Charging holes and blasting	0.5
Blowing smoke	1.0
Placing and blocking one set of timbers	4.0
Filling in behind sets, lagging, and extending pipe line	2.5
Lost time, power interruptions, changing shifts, and eating lunch	2.0
Total	28.8

The average rate of advance is taken as 150 ft. per month.

The shaft door, shown in the accompanying drawing, is placed 2½ ft. below the collar, is counterweighted, and is operated by a Tugger hoist. It is always closed while tools or materials are being loaded or unloaded from the bucket. It is closed also while the shift is getting in and out of the bucket.

At the start some trouble was experienced from the freezing up of the air hoist, but this has been entirely eliminated by the addition, on each cylinder, of two one-pint oil cups, and feeding denatured alcohol through them. Hard hats, slickers, and rubber shaft boots are supplied to the men by the company.

The sinking was accomplished without the occurrence of a serious accident.

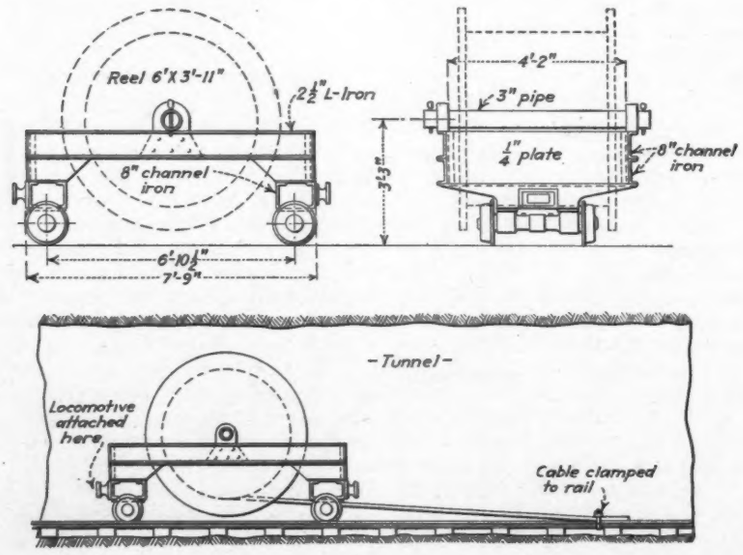
Cable Reel Carrier Simplifies Laying of Cables

OWING to the limited space available in underground workings, the laying of power cables in tunnels and drifts necessitates at least 50 per cent more men and time than is usually required for the same work on the surface. In fact, to lay some power cables at the Spiro tunnel of the Silver King Coalition Mines Company, at Park City, Utah, as many as 75 men were employed.

To reduce costs and to expedite operations in laying supplementary power cables, a specially designed cable reel carrier, as shown in the accompanying illustration, was constructed at this property. The frame is of sturdy construction, made of 8-in. channel and 2½-in. angle irons; and ¼-in. plate iron is employed to cover the sides. The complete frame rests on four wheels fitted with roller bearings.

Two supports, accommodating a short length of 3-in. pipe on which the cable reel is placed, are bolted onto the sides of the carrier. The reel is readily placed on the carrier. After first detaching one wheel truck, the frame is lifted over the reel, which is then supported on the frame by a 3-in. pipe, equipped with its two pins made of round iron. By means of two jackscrews, the end of the carrier from which the wheel truck was detached is then raised to a height sufficient to permit the bolting on of the wheel truck. The apparatus is now ready for operation. The end of the cable is clamped to the rail, and a locomotive is attached to the opposite end of the carrier. As the reel carrier is slowly drawn away from the anchored point, the cable is automatically unrolled.

The carrier described can be used only in straight tunnels or drifts. If the carrier is to be operated on curves, the rigid wheel trucks should be replaced by swivel trucks.



Flotation of Barite

AT Barstow, Calif., Cooper Shapley and his associates are treating barite-bearing tailing by flotation. The tailing came from the Waterman silver mine, which was worked about 40 years ago. The vein matter contained about 25 per cent barite, and about 45,000 tons of tailing out of 90,000 tons originally milled is available. At present the plant consists of a double-spitz K.&K. flotation machine, 10 ft. long, of a capacity of 125 tons daily. A single-spitz K.&K. machine 10 ft. long is used as a cleaner.

The tailing is transported by a horse-drawn scraper to a stockpile about 75 ft. from the flotation machines. Large lumps are broken up in the scraping, and the material is thus prepared for further handling. The sump of a 2-in. Krogh centrifugal pump is near the foot of the stockpile, and the tailing is washed into this sump with water delivered by a 1-in. hose under a pressure of 15 lb. En route to the sump the pulp passes over a screen, which removes oversize and miscellaneous materials. The centrifugal pump elevates the pulp to the rougher machine, which is supported, on timbers, 12 ft. above the ground. This affords sufficient height for tailing disposal and for gravity flow of rougher concentrate to the cleaner machine. The concentrate also flows to storage tanks. The heavy nature of the barite concentrate necessitates the use of paddles to discharge the concentrate over the lip of the machine. Tailing from the rougher is run to waste; tailing from the cleaner goes to the sump.

The specific gravity of the original tailing is 2.95; of the finished concentrate, 4.36. The latter gives the following analysis: barium sulphate, 94; silica, 1.5; calcium carbonate, 4; and iron oxide, 0.6 per cent. Long weathering and the iron stain of the barite unfits the product for use as a pigment, but it is satisfactory for other purposes. Concentrate varies in fineness from minus-80 to minus-300 mesh, and averages 65 per cent past 200 mesh.

Under present practice, the flotation agent is added at the suction of the centrifugal pump and the pulp is sufficiently conditioned to make a good separation. The flotation operation is protected by patent, which is held by the Tonopah Mining Company of Nevada. At a later date the operators plan to mine and mill barite rock and to make a barite of sufficient purity to meet the requirements of the pigment trade.

Property and Operations of

Patiño Mines and Enterprises

at Llallagua, Bolivia

R. R. Beard

THE ore, as brought from the mine, has been sledged to pass 6-in. grizzlies. It is hauled in 2-ton cars to the new coarse-crushing and sorting plant, recently completed, situated at Siglo XX. The mine cars dump the unsorted ore into a 750-ton masonry bin, from which it is discharged by a chute feeder. Then the ore passes to a 30-in. conveyor belt, for transportation to two grizzlies with manganese-steel bars spaced at 3 in. Oversize is crushed in two 13-in. McCully gyratories, set at the same opening. The grizzly undersize and the gyratory product, which join, are carried by a 24-in. conveyor to two 48-in. by 8-ft. punched-plate trommels, with 1½x3-in. slots. Trommel oversize is washed on two Leahy vibrating screens, and is then transported by a 20-in. conveyor to a 1,000-ton concrete surge bin. Screen undersize of fine sand and slime is laundered to a duplex settling tank, dried, and sent to the mill at irregular intervals.

The washed ore is removed from the surge bin by four 36-in. apron feeders, each pair discharging to a 30-in. picking belt traveling 30 ft. per minute. Space is provided for 104 women per shift, who do the sorting. The waste, assaying less than 0.50 per cent tin and constituting about 20 per cent of the ore mined, is carried by a 16-in. conveyor to a storage pile. Such ore as remains on the picking belt is crushed to 1½ in. by two No. 6 Traylor finishing gyratories, the crusher discharge joining with the undersize from the two 48-in. trommels previously mentioned. It is then conveyed to a 2,500-ton concrete bin for final storage, prior to transportation to the concentrator by railroad in cars loading 35 tons. Magnetic protection is provided for both classes of crushers.

Ore transportation from the mine to the concentrator at Catavi was done previous to 1928 by three rope tramways. Two of these, connecting with the crushed-ore bins at the Siglo XX sorting plant, had capacities of 600 and 250 metric tons per 24 hours' running time. The third tramway, with a capacity of 150 metric tons per 24 hours, connected the Cancañiri tunnel level with the mill.

As the need to move greater tonnages arose, the advisability of building a railroad spur from Catavi to Siglo XX was studied. Although the first cost would be greater than for a rope tramway capable of hauling the required amount of ore, the advantages of the railroad over a period of time were so evident that the branch was constructed. It was completed in 1928. Major economies effected include the lower cost per ton of ore hauled and the fact that supplies destined for the mine can now be delivered without trans-shipment at Catavi to mule teams and trucks.

Before the consolidation, the ores from Señor Patiño's property were treated in the Miraflores mill, at Uncia; those from the Llallagua side, in the Victoria concentrator at Catavi. The former had a capacity of 350 metric tons; the latter, 550 metric tons per day. The Miraflores mill was situated so that it was less easily accessible than that at Catavi for the ores from the lower levels of the mine. As neither of the mills was in good condition mechanically, nor had modern flow sheets, the management wisely decided to close down the Miraflores mill and to remodel and enlarge the Victoria plant for the treatment of 700 to 800 tons per day. Reconstruction, started in March, 1925, was almost completed at the end of the year.

The changing character of the ore at that time was not given due consideration. By January, 1927, the need for drastic alterations in the flow sheet and equipment became evident, to handle the required tonnage with an acceptable recovery. Previous to 1925, jig concentration began at a size of 10 mm., and 42 per cent of the total tin recovered was obtained at a size above 2 mm., and all jigs accounted for 65 per cent of the total production. Calcination produced an additional 29 per cent, leaving but 6 per cent to be recovered by all the sand tables, slime tables, and buddles. Moreover, a large amount of coarse tailing made by the jigs was immediately removed from the circuit. In 1926, the production from the jigs began to decline, indicating that the amount of cassiterite recoverable at this size was decreasing and

General view of Victoria plant

The second of a series of articles on the leading mining operation of Bolivia.

Employees' houses and tennis court, Catavi

that greater attention would have to be given to the tables, to classification, and to grinding equipment. At present, 6 per cent of the total barrilla (concentrate) is recovered by the coarse jigs, 16 per cent by the fine jigs, 16 per cent by the slime tables, 6 per cent by the calcine plant, 55 per cent by the sand tables, and 1 per cent by the buddles. Table IV illustrates the shifting which has taken place in the particle size of the recoverable cassiterite.

Plans were made in 1927 for the remodeling of the mill in accordance with the changing characteristics of the ore, and the work proceeded under authorization from the board of directors. A survey of ore reserves and the physical condition of the mine indicated that the logical program was to put the property on a high-tonnage medium-grade basis. The term "medium-grade" is only relative, however, as few large properties can boast of a mill feed with a gross value of $25 to $35 per ton. The construction program is now well advanced. Its advantages and economies have been demonstrated. Table V indicates that the capacity of the mill has been increased about three times within the last three years. Production shown therein includes a certain amount of high-grade shipping ore, or *guia*, sorted in the mine and from placers which did not pass through the concentrator.

At present the mill is in a transition stage, between the old and new flow sheets. The following remarks apply to the mill as it will be when the construction program is completed and amplify the flow sheet as shown in the accompanying cut.

The ore is conveyed from the Siglo XX sorting plant to an 1,800-metric-ton ore bin at Catavi by railroad and is of a maximum size of 1½ in. This bin is discharged by eight chute feeders and two 30-in. variable-speed conveyor belts, which transport the ore to four 48x90-in. punched-plate trommels, equipped with 16-in. x 20-mm. slots, having a slope of 1 in. to 1 ft. Trommel undersize is carried by conveyor to the crushed-ore bin. Oversize is crushed by two 57x20-in. rolls, the crusher discharge joining the original feed and again being conveyed to the trommels.

The fine-ore bin has a capacity of 2,500 metric tons, the material being distributed to it by means of an automatic tripper. The bin is discharged by five 18-in. apron feeders and two short conveyors, which in turn discharge to a 20-in. conveyor belt equipped with a Merrick weightometer. This is tested three times a week with a weighed quantity of ore and is kept accurate to within 0.5 per cent.

An automatic sampler, at the head of this belt, cuts a portion of the stream every 30 seconds. The sample is reduced by two sets of rolls to a maximum size of 2 mm., when a small part is removed for further reduction and assay. The final sample is taken by a disk distributor and cutter. After passing the sampler, the ore is divided into two parts, each going to a 16-in. conveyor, which transports the material to two banks of four vibrating screens, equipped with 6-mm. Ton-Cap cloth. Water is first added here. These screens separate the material into plus and minus 6 mm., the oversize proceeding by gravity to four 42x16-in. rolls, in closed circuit with the screens by means of two 16-in. bucket elevators. Undersize is laundered to eight 3-mm. screens, which produce an oversize, minus 6-mm. plus 3-mm., for treatment in six double four-compartment jigs, equipped with cup discharges, and an undersize that is dewatered in four 10-in. drag belts. The sand discharge from these drags is sent to eight 1-mm. screens, which make an oversize, minus 3-mm. plus 1-mm., for treatment in fine jigs similar to the ones above mentioned, and an undersize that is laundered to two Dorr classifiers equipped with 16-ft. bowls.

Only two of the compartments in both coarse and fine jigs are being operated, and these remove barrilla assaying 60 per cent tin. All jig reject is sent to six duplex classifiers for dewatering. The overflow, containing only a small amount of material, is laundered to the slime section and the sand discharge is ground in six 5x10-ft. rod mills, in closed circuit with eight 1-mm. vibrating screens and the fine jigs. Undersize from these, and overflow from the four 10-in. drag belts, are also sent to the Dorr bowl classifiers.

Tex-rope roll drive

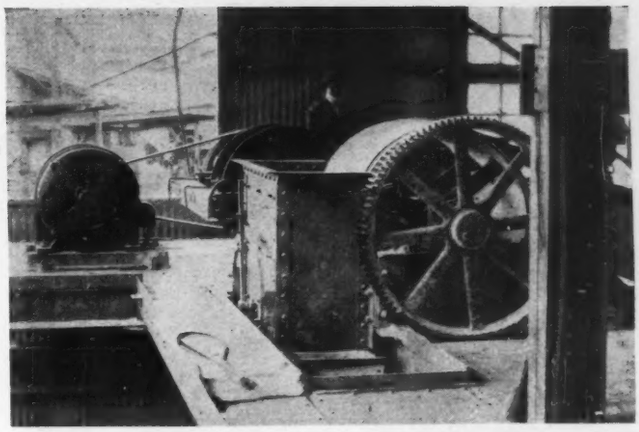
The bowl overflow, largely minus 200 mesh, is sent to the slime section. Dewatered sand, minus 1 mm. in size, is laundered to hydraulic classifiers feeding the tables. This classifier overflow joins with that from the Dorr bowl machines. The sand tables make three products: a barrilla, which is sent to the flotation plant; a middling; and a tailing. Middling from the tables treating the two finer spigot discharges is re-treated on tables for the production of barrilla; that from the tables treating the coarser sizes is sent to a dewatering cone, and thence to two 5x5-ft. ball mills in closed circuit with Dorr classifiers. That part of the fine middling not recovered by the re-treatment tables as barrilla is also sent to

Table V—Operating Statistics: Dry Metric Tons Treated

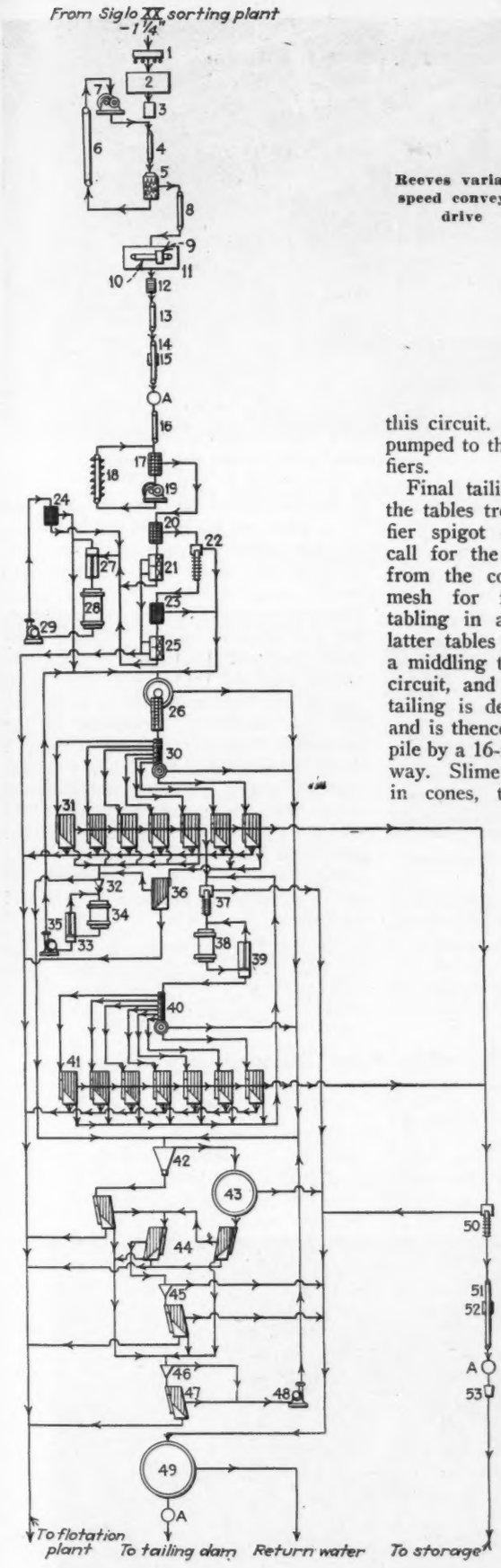
Year	Total	Per Operating Day	Tin, Per Cent	Actual Recovery, Per Cent	Fine Tin Produced, Long Tons
1925.....	144,580	508	6.65	79.88	10,032.0
1926.....	232,775	829	5.67	69.20	9,696.6
1927.....	299,858	1,038	4.97	75.88	12,155.5
1928.....	481,028	1,394	4.64	77.39	17,288.6
1929.....	703,592	2,027	3.94	76.69	20,926.3

Table IV—Per Cent of Total Tin Recovered by Sections

Year	Coarse Jigs Plus 3 Mm.	Fine Jigs 1-3 Mm.	Sand Tables	Slime Tables	Calcine Plant	Buddles
1925.....	42.0	23.0	3.6	1.1	29.6	0.7
1926.....	23.1	36.4	12.8	6.7	20.1	0.9
1927.....	8.4	48.4	13.3	9.1	19.8	1.0
1928.....	8.6	33.8	32.9	9.6	14.2	0.9
1929.....	19.4	24.0	43.8	11.7	9.8	0.7
1930 (4 months).....	13.1	19.7	48.3	13.4	8.0	0.5



Reeves variable speed conveyor drive



Proposed flow sheet of Victoria plant after completion of present remodeling

this circuit. The classifier overflow is pumped to the two primary bowl classifiers.

Final tailing is now produced from the tables treating the hydraulic-classifier spigot discharges. Future plans call for the regrinding of the tailing from the coarser tables to about 35 mesh for further classification and tabling in a separate circuit. These latter tables will then produce barrilla, a middling to be returned to the same circuit, and a final tailing. All sand tailing is dewatered in drag arrastres and is thence transported to the storage pile by a 16-in. conveyor and rope tramway. Slime and fine sand are classified in cones, the cone overflows being thickened in Dorr tanks for treatment on tables. The cone-spigot discharges, relatively free from slime, are tabled separately.

All slime tables make three products: a barrilla for flotation, a middling for re-treatment on separate tables, and a tailing for retabling. The last of three rows of slime tables produces a tailing for the buddle plant. Dorr thickener overflows are laundered to a 75-ft. thickener, the overflow being pumped back to the head tank for re-use. The thickened spigot discharge is elevated to a settling basin formed by the coarse tailing. Locally burnt lime is added to the 75-ft. thickener to produce a clear overflow, the colloidal material otherwise being extremely difficult to settle. The pH value is maintained between 6.4 and 6.8. At this point no difficulty is experienced in obtaining clear water.

Calcination, or more properly oxidizing roasting, with subsequent concentration, played a greater rôle in past operation than it does now. In 1925 about 30 per cent of the total barrilla was produced from this section, which now accounts for only about 6 per cent. This will be further decreased, probably to the vanishing point as mill construction proceeds.

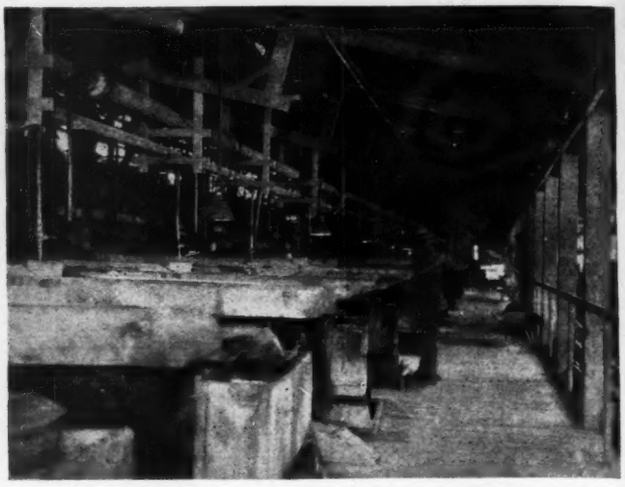
Oxidizing roasting is defined as "the heating of a metallic compound in contact with oxygen to an elevated temperature, without fusion, to effect a chemical change and to eliminate a component by volatilization." "Calcination" at Llallagua also includes subsequent grinding and gravity concentration. A silica-pyrite-cassiterite product, consisting of middling from sand tables and old-type fine jigs, is self-roasted in Kauffman furnaces. During the roasting the pyrite increases in volume and is converted to ferric oxide with a lower specific gravity, whereas the cassiterite and quartz are left almost unaltered. Decrepitation probably plays an important part, in that it releases tiny particles of cassiterite intimately associated with pyrite. The roasted material is quenched, ground, and concentrated for the production of barrilla. A large amount of slime, made by the roasting and quenching, is

Legend

1. 35-metric-ton cars
2. 2,500-metric-ton bin
3. Eight chute feeders
4. Two variable-speed conveyor belts
5. Four 48x90-in. trommels 20,mm. x 2-in. slots
6. One 24-in. conveyor belt
7. Two 57x20-in. rolls
8. One 24-in. conveyor belt
9. One 24-in. conveyor belt
10. One distributor
11. 3,100-metric-ton bin
12. Five 18-in. apron feeders
13. Two 20-in. conveyor belts
14. One 20-in. conveyor belt
15. One Merrick weightometer
16. Two 16-in. conveyor belts
17. Eight 6-mm. vibrating screens
18. Two 16-in. elevators
19. Four 42x16-in. rolls
20. Eight 3-mm. vibrating screens
21. 12 coarse jigs, 3-6 mm.
22. Four 10-in. drag belts
23. Eight 1-mm. vibrating screens
24. Eight 1-mm. vibrating screens
25. Twelve fine jigs; 1-3 mm.
26. Two bowl classifiers
27. Six Dorr duplex classifiers
28. Six 5x10-ft. rod mills
29. Twelve 3-in. pumps
30. Six hydraulic classifiers
31. Deister Plat-O tables
32. Two dewatering cones
33. Two duplex classifiers
34. Two 5x5-ft. ball mills
35. Two 3-in. pumps
36. Four Deister tables
37. Two drag belts
38. Four 5x10-ft. rod mills
39. Four duplex classifiers
40. Four hydraulic classifiers
41. Deister Plat-O tables
42. Eight cones
43. Eight thickeners
44. Forty-six Deister - Overstrom tables
45. Sixteen thickening cones
46. Three thickening cones
47. Three re-treatment tables
48. Two 2-in. pumps
49. One 75-ft. thickener
50. Three 12-in. drag belts
51. One 16-in. conveyor belt
52. One weightometer
53. One aerial tramway

A. Automatic samplers.

48x90-in. punched-plate trommels in crushing plant



Concentrating tables in the slime section

difficult to treat because of its semi-colloidal character.

In effect, calcination is necessary only because of insufficient grinding and classifying capacity within the crude section. The roasting, to a certain extent, is comparable to the combined action of a ball mill and hydraulic classifier: it breaks up the sulphide particles and releases the cassiterite; and it increases the volume, or lowers the specific gravity, of the original pyrite, thus permitting a separation to be made between the cassiterite and gangue.

Flotation can remove the pyrite from the cassiterite easily and cheaply, but any silica or alumina present in the crude barrilla remains in the final shipping product and lowers the grade correspondingly. Thus, then, milling in the crude section may be considered as an attempt at the recovery of a silica-free pyrite-cassiterite concentrate. The maximum allowable silica in this product is 4.5 per cent. When sufficient grinding and classifying equipment is installed in the crude section to obtain this class of concentrate, the calcine plant will probably cease to operate. This point is gradually approaching, as is evidenced by the fact that the recovery from this section has declined about 66 per cent in the last three years. Table VI gives operating data since 1925.

No final tailing is produced in this plant. The total reject, after being thickened, is pumped to the crude section Dorr tanks for further table treatment, whereby an additional amount of barrilla is obtained. The actual extraction in the calcine section averages about 74.5 per cent of the tin in the entering feed, and 3.0 to 3.5 per cent more is obtained from the reject in the crude section, giving a total recovery of from 77.5 to 78.0 per cent.

The elemental analyses of the mill feed and barrilla produced for shipment to the smelter are given in Table VII.

Smelter penalties are high for impurities; if the combined assay of Bi, Cu, Pb, Zn, As, and Sb is over 0.5, a penalty of 5s. per ton is imposed for each 0.10 per cent excess. Sulphur is penalized ½d. per ton for each excess 0.10 per cent over 1.75 per cent. An attempt is therefore made to keep these elements at a minimum in the shipping product.

Aërial transportation to tailing dam

Before 1926 a shipping product had to be produced within the crude section. In that year a flotation plant was constructed, the function of which was to treat a medium-grade, relatively silica-free concentrate from the crude section, for the removal of the sulphide minerals, with a consequent enrichment in the assay of the underflow to shipping-grade barrilla. The limiting factor for successful treatment is the amount of silica and alumina present in the flotation feed. To obtain a 62 per cent tin barrilla, the minimum shipping assay, the silica must not exceed 4.5 and the alumina 1.5 per cent. As the silica and alumina are present in proportion, only silica assays are ordinarily made, in addition to those for tin and sulphur.

The barrilla (concentrate) from the flotation plant and calcine section, containing about 8 per cent moisture, is hoisted to continuous dryers, where the

Table VI—Calcine Plant Operating Data

	1925	1926	1927	1928	192
Dry tons treated	21,761	25,022	24,420	30,976	28,385
Dry tons per 24 hours	63.1	73.9	71.3	86.8	81.8
Per cent of mill feed by weight	15.1	10.7	8.1	6.4	4.1
Per cent of total tin produced	29.6	20.1	19.8	14.3	10.0
Per cent in feed	11.62	9.29	12.79	12.12	11.02
Per cent tin in barrilla	64.48	61.10	63.44	64.14	64.48
Per cent sulphur in feed	26.55	19.08	27.32	27.82	25.86
Dry tons per furnace day	4.50	3.08	6.11	6.56	5.64

Hand-sewing of sacked barrilla

Table VII—Analyses of Ore Treated and Barrilla Produced

Element	Feed Assay, per Cent				Barrilla Assay, per Cent			
	1926	1927	1928	1929	1926	1927	1928	1929
Total tin	5.67	4.97	4.64	3.99	62.16	64.69	64.32	63.98
Soluble tin	0.09	0.10	0.10	0.10	0.33	0.28	0.28	0.28
Tin as SnO_2	7.10	6.21	5.78	4.95	78.66	81.95	81.48	81.04
Iron	6.66	5.30	4.12	3.82	5.19	4.18	3.97	4.10
Cu	0.08	0.17	0.16	0.19	0.13	0.26	0.17	0.18
Pb	0.07	0.22	0.17	0.22	0.12	0.18	0,17	0.19
Mn	0.06	0.10	0.12	0.10	0.14	0.13	0.05	0.13
Zn	0.16	0.21	0.15	0.31	0.26	0.20	0.13	0.26
S	5.45	4.67	4.09	3.29	6.03	3.35	3.52	3.39
As	0.20	0.12	0.08	0.10	0.64	0.20	0.19	0.13
Sb	0.09	0.49	0.11	0.10	0.11	0.24	0.06	0.02
WO_3	0.34	0.47	0.41	0.29	0.69	0.63	1.18	1.01
Al_2O_3	12.95	14.75	13.03	13.41	0.11	1.55	2.22	2.44
CaO	1.16	0.12	0.19	0.10	0.10	0.19	0.09	0.05
MgO	0.15	0.15	0.11	0.10	0.05	0.04	0.05	0.10
SiO_2	63.22	62.13	63.24	64.77	5.36	5.01	4.69	5.29
TiO_2	0.30	0.49	0.32	0.18	0.20	0.32	0.19	0.16
P	0.44	0.81	0.33	0.16	0.20	0.33	0.18	0.15
Totals	98.52	96.51	92.51	92.19	98.32	99.04	98.62	98.92

water content is reduced to about 0.35 per cent. It is then ready for sacking, which is done on a contract basis. Paper-lined jute bags are used, each containing 40 kg. (88.2 lb.) flotation or 50 kg. (110.2 lb.) of calcined barrilla. Exports are made in lots of 24 net metric tons, each sack being stenciled with the lot number, for segregation at the smelter. Shipments are made by rail to Mejillones, a port just north of Antofagasta, Chile, where they are loaded on steamers for delivery to Williams, Harvey & Company, Ltd., Bootle, Liverpool, for smelting. Production in 1929 used about 825,000 bags.

(To be concluded)

Ball-Mill Testing in the Tri-State Zinc District

C. E. Heinz
Picher, Okla.

THE purpose of a ball mill is to unlock, from the gangue, mineral which can then be economically recovered by flotation or other means.

The work of a ball mill may be expressed and classified in various ways and for various purposes, but too often the results expressed in metallurgical or mathematical terms are of little practical use to the operator seeking to know whether his ball mill is accomplishing the purpose for which it was installed.

Screen analyses of flotation tailing often show considerable loss in sizes below 200 mesh. A ball mill may defeat its own purpose by grinding too finely. The following practical test is designed to show roughly the efficiency of a ball mill in making a product from which minerals are recovered that could not have been otherwise recovered economically from the material fed to the mill. It does not readily permit comparisons of ball mills operating under different conditions and on different feeds, but it indicates what a particular mill is doing under a given set of conditions and permits comparisons with results attained under other conditions, such as changes in speed, ball load, and tonnage pulp dilution.

Disregard open- or closed-circuit grinding. Make a laboratory float test on samples of both feed and discharge of the mill. Make two products from each sample, concentrate and tailing. Establish as many constants as possible throughout the whole operation and maintain them so far as possible.

Calculate the percentage of floatable mineral in the feed and in the discharge, or the percentage of locked mineral in each. The increase in floatable mineral or the decrease in locked mineral effected by the grind is a measure of the economic efficiency of the mill.

The following outline is being followed in laboratory tests of this kind:

Charge—1,000 grams, approximately.

Reagents—$CuSO_4$—1 lb. per ton dry feed.

Sodium Aerofloat—0.5 lb. per ton dry feed.

Potassium ethyl xanthate—0.5 lb. per ton dry feed.

Pine oil—0.03 lb. per ton dry feed.

Condition for five minutes.

After conditioning, a concentrate is pulled for exactly ten minutes on an M-S type laboratory float machine. The machine is then cleaned and any mineral left in the machine is washed into the tailing. Both concentrate and tailing are dried and weighed, and the total zinc content of each is determined.

In the first example, the ball milling decreased the locked mineral 74.7 per cent or increased the floatable mineral 44.0 per cent. In the second case it decreased the locked mineral only 30.4 per cent and increased the floatable mineral only 5.5 per cent.

Obviously, the test furnishes an approximately measure of the efficiency of the ball-milling operation, and it is hoped that it may provide a starting point for more thorough and detailed study of ball-mill performance.

Ball Mill

(1)

	Feed, %	Assay Zn, %	Mineral Present, %	Floatable Mineral, %
Concentrate	6.0	61.00	3.66	62.9
Tailing	94.0	2.30	2.16	37.1
Total	100.0	Av. 5.82	5.82	100.0
	Discharge, %			
Concentrate	8.9	59.00	5.25	90.6
Tailing	91.1	0.60	.5466	9.4
	100.0	5.80	5.80	100.0

Then $\frac{37.1 - 9.4}{37.1} = 74.70$ per cent reduction in locked mineral effected;

or $\frac{90.6 - 62.9}{62.9} = 44.00$ per cent increase in floatable mineral.

(2)

	Feed, %	Assay Zn, %	Mineral Present, %	Floatable Mineral, %
Concentrate	9.0	59.5	5.355	81.9
Tailing	91.0	1.3	1.183	18.1
	100.0	Av. 653	6.538	100.0
	Discharge, %			
Concentrate	11.3	50.6	5.7178	87.4
Tailing	88.7	0.92	.8200	12.6
	100.0	6.5378	6.5378	100.0

Then $\frac{18.1 - 12.6}{18.1} = 30.4$ per cent reduction in locked mineral;

or $\frac{87.4 - 81.9}{81.9} = 5.5$ per cent increase in floatable mineral due to ball mill.

Errata

In the data on "Costs and Production of Michigan Mines," issue of Aug. 9, an error occurred in the designation of the figures in the table at the bottom of p. 134. The tonnages given are not production figures, as stated, but "Estimated Tonnage of Taxable Iron Ore." The second column under each year refers to "Assessed Valuation of Iron-Ore Properties," not to the value of production. The caption over this table should have read "State Totals of Tonnage Reserve and Valuations."

THE SUNDIAL—

Precursor of

Underground Surveying

Instruments

Henry Briggs

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WITH rare exceptions, the miners and surveyors of old did not have the writing habit. They had methods and ideas that we should be glad to know more about; but much of their lore died with them. And of the few who wrote of mining, two or three hundred years ago, a considerable proportion were not actually engaged in the industry at all; they were outsiders taking their information at second hand. Only too often they borrowed much of it from earlier treatises, with the result that a process would be given a prominence in their writings that, in the world of reality, it had long since lost. This tendency to defer to the authority of their predecessors, instead of seeking out the best practice of their time, is particularly well marked among early writers on mine surveying; the trait persisted even as late as the middle of the last century.

Fortunately, we are not altogether dependent on this literature of one of the most interesting branches of historical technology, because there exist, in a few museums and collections, dated instruments and plans which provide a more accurate indication of the progress of the mine surveyor's art.

Living in a city famous for its libraries and museums, I am fortunately situated for searching into the evolution of technical methods. For several years I have tried to trace the development of the miner's dial and of dialing, and some of the results of the inquiry may be of interest.

It soon became apparent that the specialized compass instrument, known as the miner's dial, had evolved along two main and independent lines, which have respectively provided the types generally known as the German and the English dials. A third, and relatively unimportant, variety akin to the plane table also crops up from time to time. Unlike the others, it has no continuous history, being reinvented at long intervals and then passing again into oblivion. A surmise that both the German and English dials had a common ancestor in the portable sundial was followed by an accumulation of evidence supporting that view. *Prima facie,* to attempt to prove a connection between an instrument for surveying underground and a timepiece demanding sunlight for its operation seems farfetched; but let us examine the facts.

In the first place, what exactly was a portable sundial? It was a pocket instrument having a gnomon or shadow-thrower standing over the middle of a disk graduated in hours, and, recessed within the disk, was a circular pocket holding a small compass needle used for setting the dial in the meridian. These little sundials were much favored as a cheap kind of watch or clock in Europe and England right up to the commencement of the nineteenth century, and were particularly popular from the beginning of the sixteenth to the middle of the eighteenth century, though they are known to have been used much earlier. Many of them — beautiful examples of fabrication and engraving in brass or bronze—are extant.

The early surveyor saw that by removing the gnomon from a portable sundial and by fitting a pair of sights or a pair of hooks in place of it he obtained a simple and convenient appliance for his work. As a matter of fact, there exists an actual illustration of a dial designed for either purpose. It is to be found in the earliest known work on mine surveying, written anonymously, and published with the loquacious title "Ein wolgeordnet und nutzlich Büchlin wie man Bergwerek suchen und finden soll," at Freiberg, Saxony, in 1505. This dial is circular and could be fitted with either gnomon or compass. There are two scales, both being marked in hours. The outer one extends all the way round the circle, and is for surveying, whereas the inner, which has a gap for the dark hours, is for taking the time.

Apart from the suggestive name of the instrument (for the word "dial" is derived from the Latin "dies," "a day"), and from the still more pertinent fact that, unlike the mariner's compass, most of the ancient surveying dials were graduated in hours—12 or 24 to the circle—there are several references in the literature which definitely connect the miner's dial with the sundial. One of these is to be found in the well-known book called "Mineralogia Cornubiensis," written in 1778 by William Pryce, a surgeon of Redruth, Cornwall. Pryce, who copied his description of dialing from an earlier work, introduced one original remark—and that a useful one—namely, that the miner's dial of the period was a compass without a gnomon.

Turning to publications of the previous century, nothing concerning sundials occurs in Thomas Houghton's "Rara Avis in Terris," 1681, the first treatise in English devoted to mine surveying, but there are two references, respectively dated 1670 and 1671, which are to the point. Of these the first is from the pen of a Royalist author, Sir John Pettus, who wrote a book—now very rare—"Fodinæ Regales." In it he mentions (p. 2) how the miner was directed in driving adits and drainage levels "by a needle touched with a Loadstone, the using whereof is called Dialling," and in a glossary at the end of the volume gives the following: "Dyalling of Mines, what, see p. 2, which is done with the like Instruments of Art, by which Sundials or surveighing of ground is performed."

Fig. 1—Arms of the Society of Mines Royal, showing miner's dial

The other reference will be found in the sixth volume of the "Philosophical Transactions" of the Royal Society, p. 2106; it relates to dialing in Cornish tin mines, and as it is probably the earliest description of mine surveying in the English language I give it *in extenso*.

"When we are come to any depth, and find the waters begin to annoy us, as it quickly will if any be in the work, we descend to the bottom of the Hill, where we have that Conveniency, and at the lowest place begin as little a drift as the conveniency of working or driving will permit (scarce half as big as that of the Load) in a level till we come up to our work. And here becomes the use of the Dial needful, which we term *Plummbing and Dialling* (either to know the exact place of the Tinwork where to bring out our Adit; or where to sink to bring down our Air Shaft even with the desired place, perpendicularly; or to know, which way our Load inclines, when any flexures happen); which is to to be performed in this manner, viz:

"A skilful person with an Assistant, pen, ink, paper, Sundial, and long line, after his guess of the place above ground, descend into the Adit or work, and there fasteneth the one end of the line to a fixed thing; and then lets the incited Needle rest, exactly observing at what point it stands with his pen; then he goes farther in the line still fastened, and at the next flexure in the adit makes a mark on his line, by a knot, or otherwise, and sets his Dial down again, and there likewise notes that point, on which the needle stands, at the second position; and so proceeds from turning to turning, still marking down the points, and his line, until he comes to the intended place; which performed and exactly set down, he ascends and begins at the orifice of the adit or work, and repeats what he did in the work; brings his first knot or mark in his line to such a place, as the needle will stand at the same point it did underground at the knot, and so proceeds till he comes exactly over the intended place in the mine."

Then again, almost twenty years before this account was written, namely in 1653, Leybourn, an English land surveyor, described a circumferenter divided in both degrees and hours and capable of being used as sundial or as surveying instrument.

The sundial ancestry of the surveying compass seems clear enough; yet a certain amount of specialization to make the appliance more suitable for surveying purposes took place at an early date.

The mine surveyor for a long time —until well on in the eighteenth century in England, and until the present day in the Teutonic countries—adhered to the system of stretched strings, and his dial was adapted to that system. The typical English miner's dial of the sixteenth, seventeenth, and eighteenth centuries was a compass set in a square or rectangular wooden box, the North-South or 12-o'clock line being parallel to two sides of the box—a primitive affair without a stand, and not even furnished with a lid and protecting cover of glass until early in the eighteenth century. It was merely held against a stretched cord. The contemporary Continental dial was accommodated with hooks and was suspended from the cord, and that form — the hanging compass — has persisted in Europe down to the present. But the English mine surveyor was more conservative; he did not adopt even that improvement. He retained the simple box dial without hooks or sights until, toward the end of the eighteenth century, he abandoned the stretched cord entirely. The land surveyor, on the other hand, being unable to use strings with any facility, placed his compass on a stand and fitted sights to it. He was a more progressive person than his mining confrère and he effected important improvements in the instrument.

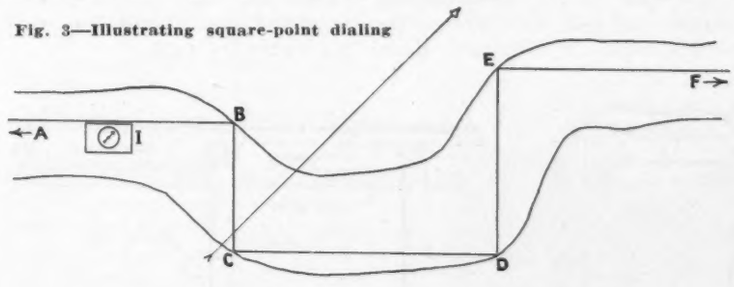


Fig. 3—Illustrating square-point dialing

Fig. 2—Arms of Society for the Minerals and the Buttery Works, showing quadrant

In the Orrery collection at Christ Church, Oxford, there is, for example, a land surveyor's circumferenter by Worgan, and dated 1690, of singularly modern appearance. It has two pairs of slit-and-hair sights and a jointed tripod provided with a workmanlike ball-and-socket leveling attachment. In design and construction it is nearly a hundred years ahead of contemporary mine surveying practice.

The English miner's dial of the present day is not strictly a miner's instrument at all; it is the eighteenth century land surveyor's circumferenter adapted to underground conditions. To all appearances, it was originally put to mining uses in Cornwall, and it was in that region that, some years later, "fast-needle dialling" was first introduced, thanks to the invention of the venier dial by W. and S. Jones, London instrument makers, in 1797. Its suitability must soon have received widespread recognition, for the box dial and the stretched string quickly passed into limbo in Great Britain.

Now, so far as I am aware, there is no example of the ancient box dial in existence, and the likelihood of finding one extant at the present time is remote. By a lucky chance, however, an unmistakable illustration of the instrument is preserved in a coat-of-arms (Fig. 1), and, inasmuch as the arms were granted by Queen Elizabeth to the Society of the Mines Royal in 1568, they carry the history of surveying in English metal mines back to twenty years before the Spanish Armada. The Society of the Mines Royal was a corporation of 24 persons exercising the sole right of working gold, silver, copper, and certain other ores within eight English counties and the whole of Wales. A similar prerogative was enjoyed by a second corporation, bearing the quaint name of the Society for the Minerals and the Buttery Works, in regard to the remainder of the Kingdom, and this society's arms (Fig. 2) are also of interest from our present point of view. These two coats-of-arms, which were

bestowed at the same time, are reproduced in Pettus' "Fodinæ Regales." The first includes a spirited picture of a gad-man at work underground and of the double-flame lamp he used. The supporter on the left is described as a hammerman and that on the right as a smelter with a fork. At the top is the half figure of a mine overman or shift boss of the period, with a wedge in one hand and a dial, divided into twelve hours, in the other. The chief interest of the second coat-of-arms resides in the quadrant carried by the female figure on the left side—an instrument used for a long time in land and mine surveying for taking vertical and horizontal angles. The torpedo-shaped object borne aloft by two arms is described as a cake of copper.

Though entering on no detail, the English mathematician Leonard Digges, in his notable treatise the "Pantometria," 1571, mentions that the compass was mainly employed for underground surveying. The earliest actual description of the method of using the ancient box dial which I have so far been able to trace is, however, that quoted above from the "Philosophical Transactions" of 1671. It was followed by the detailed accounts of Houghton in "Rara Avis in Terris," 1681, and of Hardy in the "Miner's Guide," 1748. To grasp these processes, one should remember that the main objective of the old surveyors was not to construct a plan of the workings but to ascertain at the surface a position immediately over some point underground. They laid out the survey on the surface to full scale. Hence any method which would facilitate this operation was likely to be favored. The process of "square-point dialling," described by Houghton and Hardy and later by Pryce, curious though it may appear to modern eyes, was admirably suited to this purpose. It was a process of dialing by rectangular co-ordinates.

In square-point dialing two bearings only were made use of—namely, the mean direction of dip of the vein and the mean direction of strike. These directions, mutually at right angles, were known respectively as the "square-point" and the "rakeways-point" or "bye-point." In my explanatory figure (Fig. 3), rakeways-point is 1½ hours (N. 45 deg. E.), and square-point 4½ hours (S. 45 deg. E.). A string *AB* was stretched from a fixed point *A;* the dial, *I*, was held against it, and the string and dial were moved together until the needle stood at rakeways-point; a mark was then made at *B* where the string reached the wall. After taking the length of the line *AB*, the string was stretched across the level from *B* to *C;* the dial was held against it, and the end *C* adjusted in position until the needle read square-point—and so on. Having in due course reached the place whose surface position was required, the algebraic sum was taken of the two co-ordinate distances. The surface point was then ascertainable from two measurements, respectively in the "rakeways" and "square" directions, commencing from the center of the shaft.

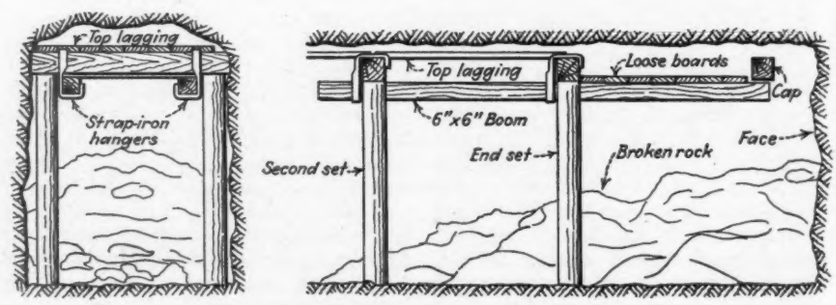
Though the standard method of the period, square-point dialing was not the only process employed. The description quoted above from the "Philosophical Transactions" is of "straight" traversing in which the bearings of the lines were read and booked, no attempt being made to adjust the string to lie in any special direction. Also, the expedient of putting knots on the string (numbered in some manner to correspond with the lines) did away with the necessity of employing a chain or measuring rod.

The mine-surveying instrument akin to the plane table to which reference was made at the beginning of this paper consisted, in its first and most primitive form, of a board supported on a stool or tripod. Here again a string was stretched along the roadway; the board was set up below the string, which was chalked, and oriented by turning it round until a magnetic needle stood over an index mark; the taut string was then plucked so that it struck the board, thus marking its own direction upon the latter. The board became the protractor for reconstructing the traverse at the surface. Agricola depicts an instrument of this class in "De Re Metallica," 1556. It had a compass box, graduated in hours and quarters, recessed into the center of a circular table. Surrounding the compass were seven concentric rings filled with wax, upon the surface of which the directions of the strings could be marked by scratches. Passing into disusage during the following century, the instrument was reinvented in France early in the seventeen hundreds. It was now provided with a pivoted sighting alidade or a telescope, and a disk of pasteboard, centralized by means of the projecting pivot after the fashion of a gramophone record, was placed on the table and secured by screws. The lines were drawn across the disk, using the alidade as ruler. Again the type passed into oblivion, and again it was reinvented. This latest reincarnation, dated 1896 and due to James Henderson, a Cornish surveyor, was called the "rapid traverser" or "duffer's dial," Allowing for mechanical improvements, it was in all essentials the same as the French instrument which preceded it by at least 170 years, except that Henderson used enameled-zinc disks instead of cardboard.

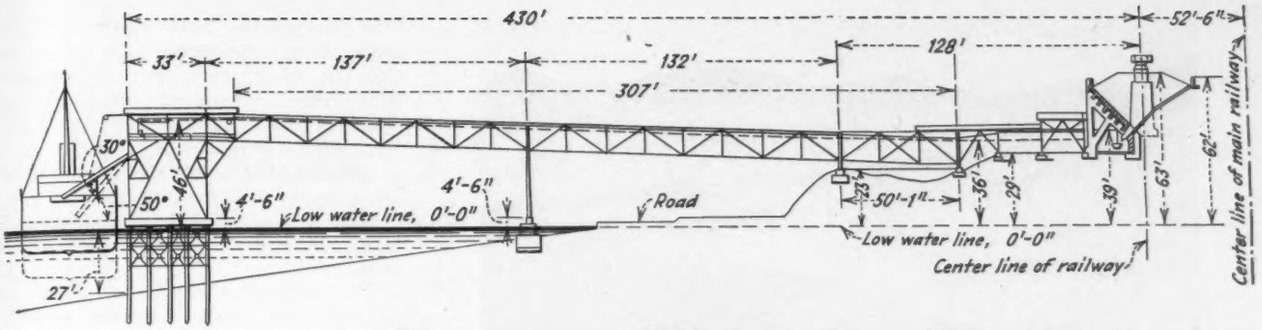
Cantilever Roof Affords Protection to Muckers

DRIFTING in loose or broken-up ground is both dangerous and costly, and under such conditions timbering must be employed close to the face. Moreover, numerous accidents caused by falling rock and cave-ins happen every year in the course of such operations, and the use of any device that will afford adequate protection to workmen, especially to muckers, is advisable.

A simple and effective piece of apparatus, shown in the accompanying illustration, has been developed at the Utah-Apex mine, at Bingham, Utah. This contrivance consists of two 6x6-in. booms, four strap-iron hangers, and a number of short planks. After each round has been fired, and before mucking operations are started, the two booms are placed in the four hangers, which are suspended from the caps of the end and second sets. The booms are then moved so that they reach the face, and short planks, to act as a temporary top lagging, are placed on them. Before drilling is resumed, the planks are removed and both booms pushed back, providing ample space for the drilling machinery and men.



A temporary cantilever roof to protect muckers from falling rock



Plan and elevation of the Rigen suspension ropeway

Ore to Ship by Ropeway in Korea

Ritaro Hirota

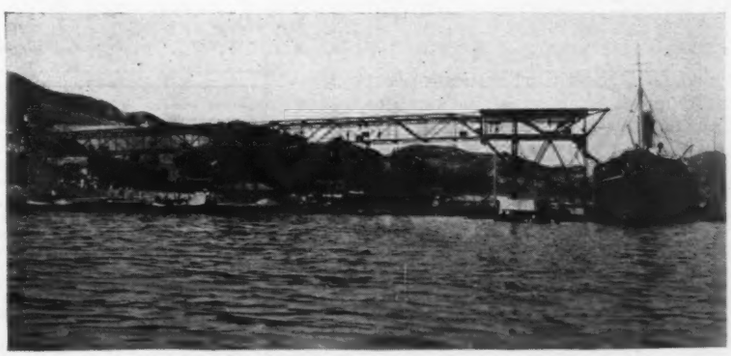
Consulting engineer, Tokyo, Japan

ALTHOUGH labor is cheap in the Orient, and mechanical handling is not an absolute necessity, Japan was not slow to adopt improved means of transportation and mechanical handling methods. As early as 1890 the first monocable ropeway was built to bring out copper ingots from the famous Nikko and Ashio copper mine, and to carry inland the coke and provisions needed. The line, 2⅛ miles long, with a capacity of three tons per hour, was the Hallidie system, supplied by Roe & Bedlington, of England. Since that time, several ropeways have been built, but mostly on the monocable system.

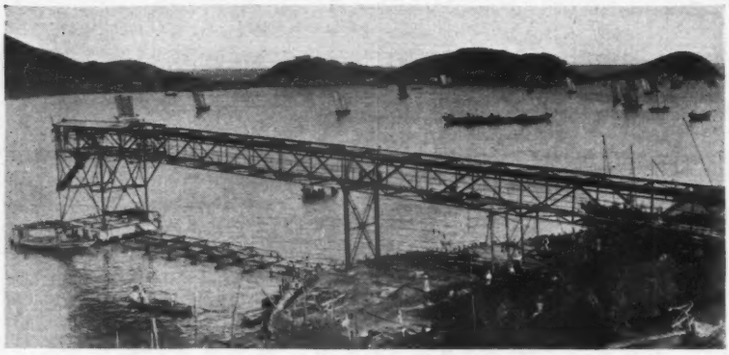
In 1901, the first bicable ropeway was introduced to Japan by Adolf Bleichert & Company, of Leipzig, Germany. Of the two principal lines built, one was 6½ miles long. This was constructed for transporting timber to the Ashio mine. The other, 2¼ miles long, was erected to carry copper ores from the Besshi copper mine to a terminal 2,000 ft. lower than the upper loading point. This ropeway is still running satisfactorily after 29 years of continuous service. It will be dispensed with soon, however, when the ores will be transported through the newly completed adit level. During the present century many ropeways have been built in Japan, mostly by Japanese. The Tamamura installations predominate; about 250 of these lines, totaling to about 500 miles, have been built. Several lines have also been supplied by Ceretti & Tanfani, of Italy.

Such ropeways are intended mostly to transport goods over hills, valleys, and rivers; they were never tried for the direct loading of ore into ships. However, the directors of the Rigen Iron Mine Company were well advised in listening to the advice of their consulting engineer, Dr. S. Niwa, who recommended a ropeway for this purpose. The outcome has been entirely satisfactory. The installation to be described is an example of wise pioneer effort in Japan in loading ores at the seaport.

Rigen iron mine is in the northern part of Korea, and is connected to the Port of Shako, which faces the Japan Sea, by nine miles of railway. Ores are brought to the port and there stored in a bin of 5,000 tons' capacity, erected about 40 ft. above sea level. Through eight Bleichert U-type chutes, the material is fed to the ropeway buckets. These, as usual, are pushed on by hand to be caught by the hauling rope, after passing the weighing machine. They are then carried forward over a rail line to the discharging terminal. This rail line is supported by the steel girder bridge which is 430 ft. long and extends from the bin to the pier. The line has a rising 2¾ per cent grade toward the pier. A bucket holds 1⅛ tons, and 180 buckets, or 200 tons, are hauled in an hour. The ore is dumped automatically into the ship's hold through the telescopic chute, the bucket being fitted with a Bleichert automat clip. Power for driving the ropeway is supplied by



Cargo steamship "Niitaka Maru" (3,400 tons) loading ore



Suspension ropeway and truss bridge, as seen from the ore bin

a 10-hp. Diesel oil engine. About a dozen laborers are employed for charging of buckets.

The new ropeway loading arrangement has effected to the company a considerable saving, as compared with the cost of the old method of loading from barges, with the aid of ship's winches. Moreover, the time required for loading has been reduced more than 50 per cent. This has enabled steamers to make more trips in a specified time.

Accompanying halftones and drawings show the details of the ropeway. The photographs from which the halftones were reproduced were taken on Oct. 10, 1929, when the first steamer was loaded. Tonnage cargo of the steamers varies between 3,000 and 5,000 tons. Only one loading chute is used at present, but it is the intention of the company to extend the hanging rail, to make a loop, so that two hatches can be served by the equipment at the same time.

The ropeway, which has been in operation for more than six months, with an entire absence of trouble or breakdown, was supplied by Adolf Bleichert & Company through that company's agents, C. Illies & Co., Tokyo. Credit is also due to the directors of Rigen company, Y. Kamewari, E. Obata, S. Kumaki, and others, who supported and acted on the recommendation of Dr. S. Niwa, of Tokyo, an authority on harbor engineering in Japan.

Burner Change Increases Boiler Capacity

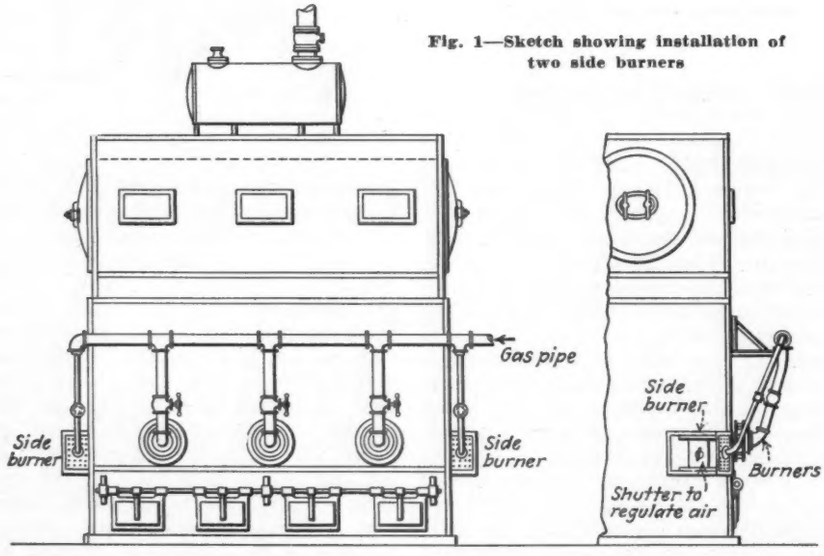


Fig. 1—Sketch showing installation of two side burners

AT the U. S. Steel Corporation's plant at Ironton, Utah, two side burners are used in addition to the three main gas burners on each boiler generating steam for the power house. These extra burners, placed at the two front corners of the fire chamber as shown in Fig. 1, introduce the flame in a diagonal direction to the chamber. The burner proper consists of a hollow cast-iron body, provided with a connection to receive the main gas pipe, and a series of 1-in. distributing pipes, as illustrated in Fig. 2. On the opposite side the cast-iron body is equipped with pipe plugs to facilitate the cleaning of the distributing pipes without interrupting operations and removing the burner from the sheet-iron frame which is bolted onto the boiler walls. The burner frame, of $\frac{1}{8}$-in. sheet-iron, reinforced with small angle irons, is equipped with a sliding shutter for regulating the air necessary for combustion. Coke-oven gas is used exclusively as a fuel for these burners. With this installation the capacity of the 670-hp. boilers has been increased to 1,000 hp., and the use of additional boiler equipment thus rendered unnecessary.

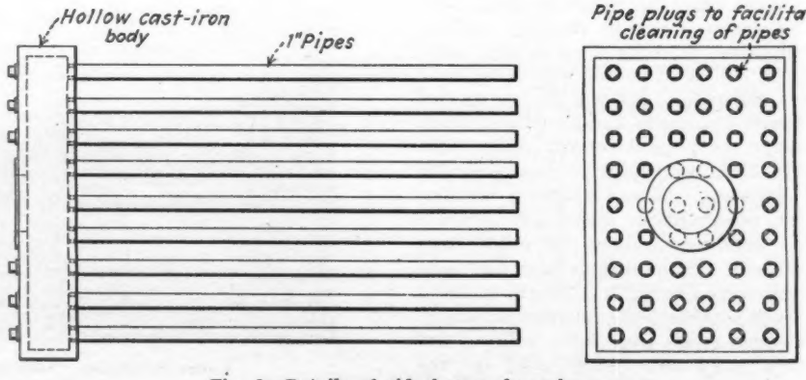


Fig. 2—Details of side burner for coke oven

TRACK TURNOUT CHART

Designed and Copyrighted by

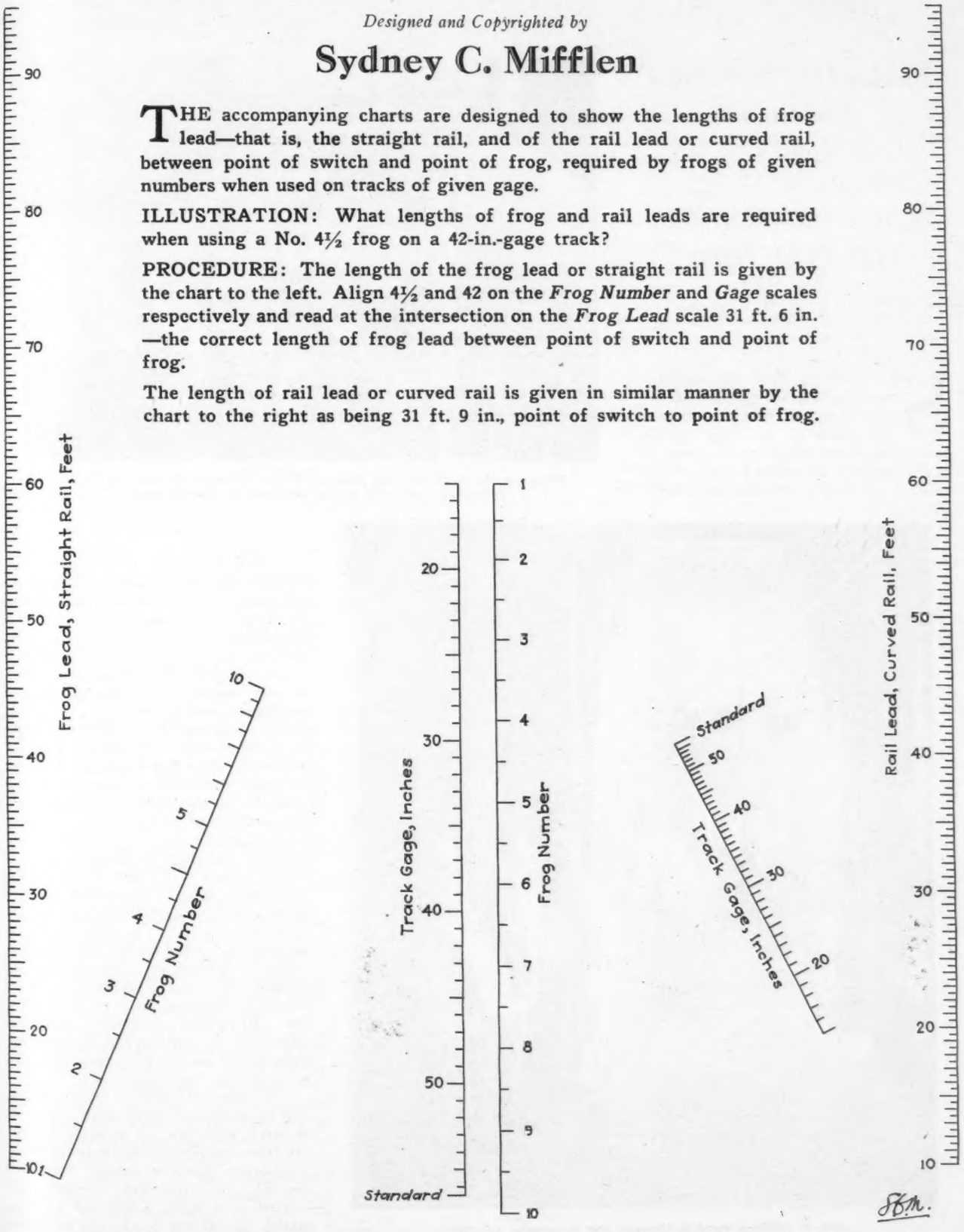
Sydney C. Mifflen

THE accompanying charts are designed to show the lengths of frog lead—that is, the straight rail, and of the rail lead or curved rail, between point of switch and point of frog, required by frogs of given numbers when used on tracks of given gage.

ILLUSTRATION: What lengths of frog and rail leads are required when using a No. 4½ frog on a 42-in.-gage track?

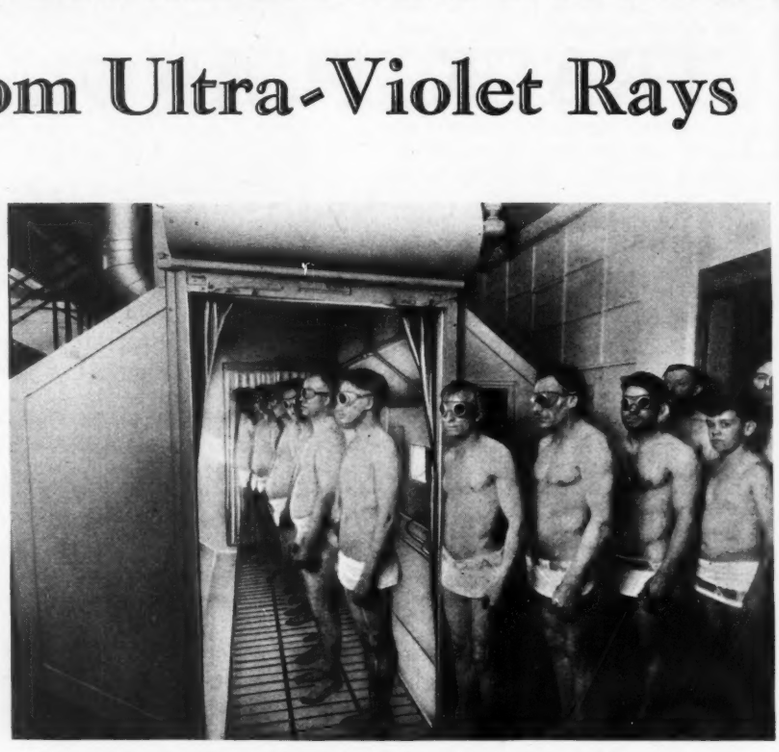
PROCEDURE: The length of the frog lead or straight rail is given by the chart to the left. Align 4½ and 42 on the *Frog Number* and *Gage* scales respectively and read at the intersection on the *Frog Lead* scale 31 ft. 6 in. —the correct length of frog lead between point of switch and point of frog.

The length of rail lead or curved rail is given in similar manner by the chart to the right as being 31 ft. 9 in., point of switch to point of frog.



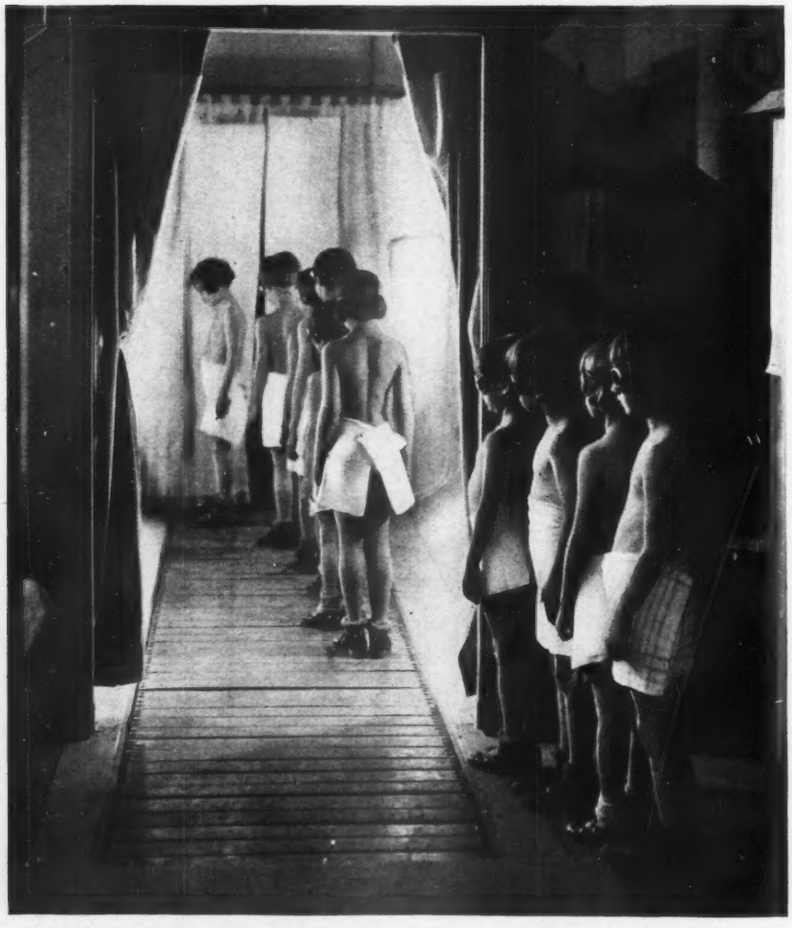
Mine Employees and Their Families Benefit From Ultra-Violet Rays

Bunker Hill & Sullivan Pioneers in Continuous Process Treatment Plant, in Successful Operation at Kellogg, Idaho



Miners in the employ of the Bunker Hill & Sullivan company undergoing violet-ray treatment in the solarium at Kellogg, Idaho

STATISTICS show that respiratory diseases are responsible for most absences from work, and that much of the time lost is during the winter months, when there is a deficiency of ultra-violet rays. However, most indoor workers, especially miners, are not exposed to sunshine sufficiently to keep them in good health at any period throughout the year. The ultra-violet rays in natural sunshine are efficient only between 10 and 2 or 3 in most localities in the temperate zone. Indoor workers are able to receive practically none of this.



School children passing through the automatic solarium

The Bunker Hill & Sullivan Mining & Concentrating Company, Kellogg, Idaho, installed last year an automatic solarium, capable of treating 300 to 350 cases per hour, supplied by the Burdick Corporation, of Milton, Wis., the purpose of which was to provide a substitute for sunshine for underground and office workers. The company made the investment after a seven-year experiment with one ultra-violet lamp in its industrial hospital. This lamp was used mainly on pathological cases, but a sufficient number of cases of anemia, malnutrition, and general run-down condition received such benefit from the ultra-violet treatment that the officers of the company decided that the light would do much to help all workers and their families as well.

The solarium consists of a cabinet, 100 in. wide and 12 ft. long and 109¾ in. high, in which six quartz mercury-arc lamps supply the health-giving rays. A moving platform carries those receiving the treatment through the cabinet at a speed which can be regulated, so that the dosage can be main-

tained accurately. The solarium is an adjunct of the change house. After taking a shower bath, the men step on to the moving platform and take an ultra-violet "ride" before dressing. The women and children of the community are allowed to take treatments at certain hours during the day. Many of the mothers walk a long distance, carrying or wheeling a baby for treatment. This would indicate that they are impressed with the good results obtained. The school children are also regularly irradiated, with evidence of good results.

Mr. Stanly A. Easton, vice-president and general manager of the Bunker Hill & Sullivan company, states that results so far have been most encouraging. "Our records," he says, "show that up to the end of February, 1930, 29,000 treatments, more or less, were given to men, women, and children. From a large number of records of individual cases reported by our Industrial Nurse, I quote as follows:

"'Case No. 1. Suffered from colds and flu every winter, former weight 95 lb.; no colds or flu during the past winter at all; never missed a treatment; now weighs 110 lb.

"'Case No. 2. Lost one or two days every month from colds; has taken ultra-violet faithfully and has lost no time this past winter at all.

"'Case No. 3. (Woman) Never been able to gain weight, maximum 118 lb.; now 131.

"'Case No. 4. Anemic, low blood count; hemoglobin count now normal, better than 85.

"'Case No. 5. Rheumatic and generally run down, normal weight 175 lb.; run down to 130 lb.; before taking treatments unable to work; use of cane or crutch necessary; took treatments regularly, present weight 180 pounds, discarded cane, now back to work.'

"I could give you a number of similar cases," Mr. Easton adds, "but the above are typical. I realize that the improvement may have been stimulated by a better mental condition in some cases, though there is no question that, as a rule, it is very real and substantial. Our chief problem now is to interest a larger number of our employees, especially many individuals who are in direct need of such treatment. I am confident that during the coming winter a better interest will be evinced, and that in succeeding years treatments will be taken as a matter of course and the benefits uniformly recognized among our large group of employees in all departments."

The operation of the solarium at Kellogg, which was discontinued on June 1, will be resumed early in September.

Upkeep of Electric Locomotives

J. S. Dean

Westinghouse Electric & Manufacturing Company, Homewood, Pa.

THE work of properly maintaining electric-locomotive equipment is simplified if the mechanical department has been thoroughly organized, accurate records of locomotive troubles are available, and all locomotives are regularly and systematically inspected. Some of the methods of maintenance and repair of such equipment will be given in detail, to assist the mechanical organization to more readily handle this line of work.

The cores for the older types of mine motors were built up with laminations that had a loose fit on the shaft or the spider. These cores, with spider construction, were held in place by a ring key. On the more modern motors the laminations have a tight driving fit on the shaft or the spider. The ring key has been replaced by a ring nut, to hold the laminations together on the spider. In addition, in modern spider construction, the rear end bell is cast integral with the spider. All these improvements tend to produce a more rigid and dependable assembly of the cores.

In assembling commutators, extreme care must be taken to keep out dust and moisture from the machined segments and the mica details, neglect of which precaution on the part of the workmen may result in a short-circuited or grounded commutator. It is of the utmost importance to use high-grade mica cones and insulating bushings. Clean out the "vees" on the assembled copper and mica segments, using fine sandpaper. Thoroughly blow out all the dirt and dust, and test for short circuits as given in the following table. The assembled commutator should be heated to a temperature from 125 to 150 deg. C., and pressed while hot at from 20 to 30 tons, depending upon its size. While hot and under pressure the locking ring nut or bolts should be drawn up tight.

The front "vee" should be protected against dirt and oil by giving this surface a smooth slick finish, so that it can be cleaned readily by wiping with a clean cloth. A layer of loosely woven four-ply twine, well shellacked and smoothed with a hot soldering copper and then given several coats of a good grade of insulating varnish, furnishes a solid, smooth, and good protection at this point. It is advisable to round off the edges at both ends of the face of the commutator and to undercut the mica to a depth of $\frac{1}{64}$ to $\frac{1}{32}$ in. This must be done with care. Be sure that all small slivers of mica in the slots between the bars are removed. All repaired commutators should be tested with alternating current as follows:

Operating Voltage, Volts	Test Between Bars, Volts	Final Test to Ground, Volts
500	300	2,000
250	200	1,000

In general, the shafts of a large number of the mine locomotive motors are made from special axle steel. A few of the more modern types of motors, however, in order to secure additional strength, use heat-treated axle or alloy steel. In most shaft replacements, standard axle steel is satisfactory. However, where considerable trouble from shaft breakage is experienced, the higher-grade heat-treated axle or alloy steel shafts should be used to secure an additional factor of safety. Heat-treated axle steel is 44 per cent stronger, and heat-treated alloy steel is 77 per cent stronger, than the untreated axle steel. All bearing seats should be ground and polished to get a smooth, slick finish. Shafts should be made a tight press fit, requiring from 15 to 25 tons' pressure to force same in place on cores of motors from 25 to 50 hp. in size.

The armature winder should be provided with the necessary tools—such as rawhide mallet, steel, and fiber drifts, screw drivers, pliers, scissors—suitable for making a good winding job. Improper tools in the hands of the average winder, although the best of coils may be used, may result in a poor winding job that will not stand up in service.

The most satisfactory results in rewinding armatures can be obtained only by using armature coils made from good-quality copper, insulated with high-grade fibrous materials, or a combination of these materials with mica, and wound to the correct shape. If poorly shaped, the coils will not only be abused and damaged while winding, but they will require a much longer time for the winder to finish the job. The insulation should be carefully re-

The second of a series of articles on this subject. the first of which appeared in the issue of June 7.

inforced at cross-overs and corners, and finished coils thoroughly treated by dipping and baking in a high-grade insulating varnish.

All sharp corners and roughness in the slots that might damage the winding should be removed by filing, or with a small, portable abrasive wheel. The insulating-material places on the coil support should be evenly spaced, to avoid thin, unprotected spots. All coils should fit snugly in the slots and should be wound so that the tops of the coils extend about ⅛ in. above the band grooves. This is essential for a good, tight, banding job. In winding, the coils should not be twisted, bent, or abused any more than may be necessary to get them in place. Insulating or protecting pieces should be placed at all points where coils or leads cross each other and where there is danger of short-circuiting. Correct winding information, with a diagram of connections, should be obtained from the manufacturer of the motors.

In soldering the leads to the commutator, the soldering copper or tool should preferably be held at the side of the commutator rather than on the top, and the pinion end of the armature should be raised about 6 or 8 in. This procedure tends to prevent the solder from running in back of the necks and short-circuiting adjacent commutator bars. While soldering, do not use acid flux, which tends to weaken the insulating material on the coils. A flux composed of alcohol and rosin gives good results. The best practice in soldering is to use a high percentage tin-base solder for wire-wound jobs, and pure strip tin on strap-wound armatures. A heavy soldering copper, weighing about 4 lb., gives best results when soldering. It must be kept clean, well tinned, and hot while being used.

All rewound and repaired armatures should be partly banded and then heated at a temperature of 105 to 115 deg. C., from 8 to 12 hours, depending upon their size, and dipped, pinion end down, in a good grade of black insulating varnish. After draining, they are baked at a temperature of from 115 to 125 deg. C. (239 to 257 deg. F.), for 16 to 22 hours, depending upon their size. This treatment, which fills all cracks and openings in the insulating material, greatly reduces the possibility of breakdowns that may be caused by moisture and other conducting materials filling these cracks. Further, this treatment acts as a bond to prevent vibration. The equipment necessary to handle this work is a tank for the varnish, a baking oven, preferably electrically heated and fitted with automatic temperature control, and the necessary apparatus to handle the armatures.

The most satisfactory results are obtained by banding the armature after it has been heated and the windings have been drawn down in place by means of temporary bands. A good grade of tinned steel banding wire ranging in size from No. 14 to No. 17, Brown & Sharpe gage, should be used, with tensions ranging from 100 to 300 lb. A strip of tin placed under the core band tends to strengthen and make these bands less likely to work loose in service. All bands should be soldered, using pure tin because it has a higher melting point than the half-and-half solder, and, therefore, will stand higher operating temperatures before it will soften and fail under severe service conditions. A special alloy has been developed, now being used to solder armature bands, which has a melting point that is about 30 per cent higher than that of pure tin.

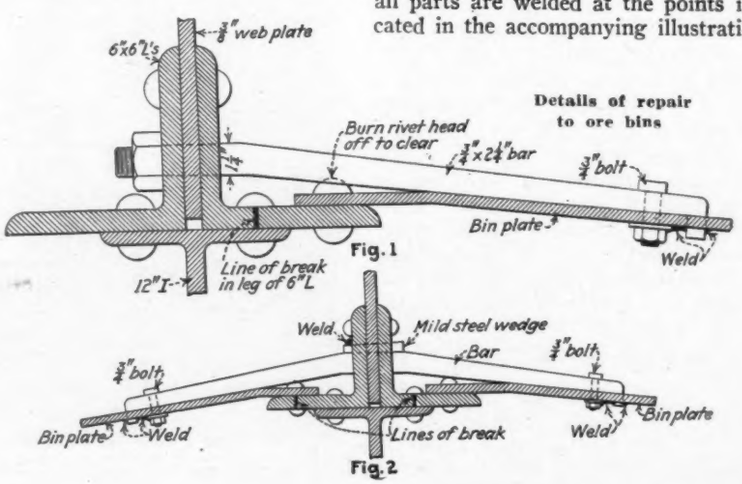
Armatures during the process of rewinding should be given various tests, such as a ground test of 2,000 volts, for 500-volt armatures, and 1,000 volts for 250-volt armatures. This should be done after all coils are in place and the bottom leads have been connected to the commutator. Before connecting them to the commutator, the top leads should be lighted out to see that there are no crossed coils. Before final soldering, test for short and open circuits, using a testing yoke, bar to bar test, or a telephone-receiver outfit. After soldering, the finished armature should again be tested for ground, open, and short circuits. Recommended ground tests for rewound and repaired armatures are as follows, using alternating current:

Operating Voltage Volts	Rewound Jobs, Volts	Repaired Jobs Volts
500	2,000	1,200
250	1,000	600

Ore Bins Rendered Safe by Novel Repairs

AN INNOVATION at the Nevada Consolidated Copper Company's plant at Hayden, Ariz., is the method of efficiently repairing the storage bins in the main mill. The bins are of reinforced all-steel construction, and are divided into eight sections by several steel columns made of 6-in. angle irons and 12-in. I-beams. Failures were experienced at this point, in the form of cracks extending in places more than 20 ft. high and wide enough to permit leakage of ore particles, which entailed considerable trouble and danger. After many experiments, the method to be described was developed, with which good results have been obtained at low cost:

The cracked section of the bin shell is first pressed back into its original position with the aid of jackscrews and block and tackle. Then the holes to accommodate the drawbar and anchoring bolts are burnt into the shell and 6-in. angle irons of the column by means of an acetylene torch, as illustrated in Fig. 1. All drawbars are forged from a ¾x2¼-in. mild-steel material, one end being bent at an angle of 90 deg., with a ¾-in. hole provided for a steel bolt to effect a tight anchoring to the shell plate. The opposite end, with its 1¼-in. thread, enables the repair man to further press the shell into perfect alignment and to keep it in such position. Because of a greater pressure prevailing in the lower sections of the bin, the drawbars are placed at 9-in. intervals along the crack, whereas a 12-in. spacing is entirely satisfactory for the upper sections. When failures occur on both sides of the column, bars of a clamp type are then employed, as shown in Fig. 2. A rectangular hole, large enough to permit the inserting of the bar, is burnt into the 6-in. angle irons and the columns, instead of the round hole shown in Fig. 1. The bent ends of the bars are then placed into the corresponding rectangular slots of the shell, and secured by two ¾-in. bolts and a tight-fitting iron wedge. To afford additional security and strength, all parts are welded at the points indicated in the accompanying illustrations.



Tailing piles and surface plants along the Central Rand make a colorful mining scene

The Witwatersrand Gold Field

Owen Letcher

Johannesburg, South Africa

ADEQUACY and efficiency of native labor supply are **and have** been the principal limiting factors in production by the gold mines of the Witwatersrand, in South Africa. With the number of native laborers now employed—more than 200,000—the Rand, despite increasing depth and lengthening haulages, is surpassing the level of production in 1929. Last year's output was the highest ever registered in the history of the fields, and the current year will probably witness the setting up of another record, for the Rand is expected to produce in 1930 more than 10,000,000 oz. of gold.

South Africa is suffering in common with the rest of the world from the effects of an acute depression in commodity prices. The mines of the Rand, which purchase stores and supplies to the value of more than $70,000,000 annually, will benefit from lower prices. Gold has a fixed price of £4.24773 per ounce, so that, in a world of falling values, the gold-mining industry is most fortunately circumstanced. Whether the decline in commodity prices will be sufficient to offset the incidence of greater working depth, greater lateral haulages, and the rising tendency of phthisis compensation remains to be seen, but the probabilities are that, if the mines do not suffer any very material seasonal contraction in the number of native laborers available later on in the year, profits and dividends during 1930 will exhibit a material increase over earnings for 1929 and 1928. The aggregate profit for the first quarter of 1930 has been £3,221,228, compared with £3,147,072 for the corresponding period of 1929. The profit for April, 1930, was £1,041,739.

An examination of the cardinal statistics relating to development and output on the Rand during the last decade shows a fairly consistent tendency for tonnages hoisted and milled to expand. In development footage there has been an enormous increase; in fact, the number of feet driven, sunk, and raised today is very nearly twice as much as ten years ago. The detailed statistics attached to this article render this clear. Each year, too, the tendency is for the grade of ore milled to register a fractional decline, which, over a period of seven years, has been offset by a correspondingly small decrease in working expenditure per ton milled. In considering these statistics, the reader must remember that in the early part of 1922 a strike and revolution threw the mills of the Rand out of action for two and a half months. That year is not therefore strictly comparable with other annual periods, but since then there has been enormous expansion in tonnages handled and in development footage, although there has been no corresponding gain in profits earned.

The Rand year after year has confounded the critics who so stoutly maintained that the zenith of production had been reached. Each year has added something to the output of the preceding twelve months until, in 1929, the Witwatersrand produced 9,979,106 oz. of gold. Nearly all of this increased gold output has been won from the Far East Rand, that great subsidiary basin of the originally operated field. The proportion of output secured from the area lying east of Boksburg has shown steady increases, and each succeeding year witnesses the expansion of the field of activity eastward and southeastward in the Nigel-Heidelberg section. While this process of expansion has been developing on the Far East Rand, the mines of the Central, Near East, and West sections have deepened their shafts until a maximum of nearly 7,700 ft. has been reached in the area lying immediately south of Johannesburg.

In the central area the older outcrop mines, such as the Ferreira, Wolhuter, and New Primrose, have exhausted their ore reserves. The Meyer & Charlton is approaching the end of its career. In the City Deep mine, grade has

Durban Roodepoort Deep's metallurgical works and shaft headframe, on the West Rand

dropped to such an extent that the company has been involved in losses amounting to about £300,000 during the last two or three years. Crown Mines has fully maintained its position as one of the greatest mining undertakings of the world and has continued to conduct operations on a greater scale than any other gold mine, either in South Africa or elsewhere. Through the courage and ability of its management, and because of the absorption of the Cinderella claims, East Rand Proprietary has been pulled around to a stage of profit earning again. Robinson Deep has extended its life for several years by absorbing Village Deep. Simmer & Jack has been reorganized and has absorbed claims on the dip of its original property.

In the Western section, Consolidated Main Reef is acquiring more ground. Aurora West has been exhausted, but there has been a marked improvement in the affairs and prospects of Durban Roodepoort Deep, Luipaardsvlei Estate, and West Rand Consolidated. Randfontein, that most difficult of all mines on the Rand, has managed to maintain the scale of its operations at about 2,500,000 tons of 4.7-dwt. ore annually and to meet its debenture obligations. For these sections of the Witwatersrand, prospects of expansion are few, but, provided no material contraction occurs in native labor supply, the Central, Near East, and West Rand areas should maintain their output for some years to come—probably for the next five years and quite possibly for ten years.

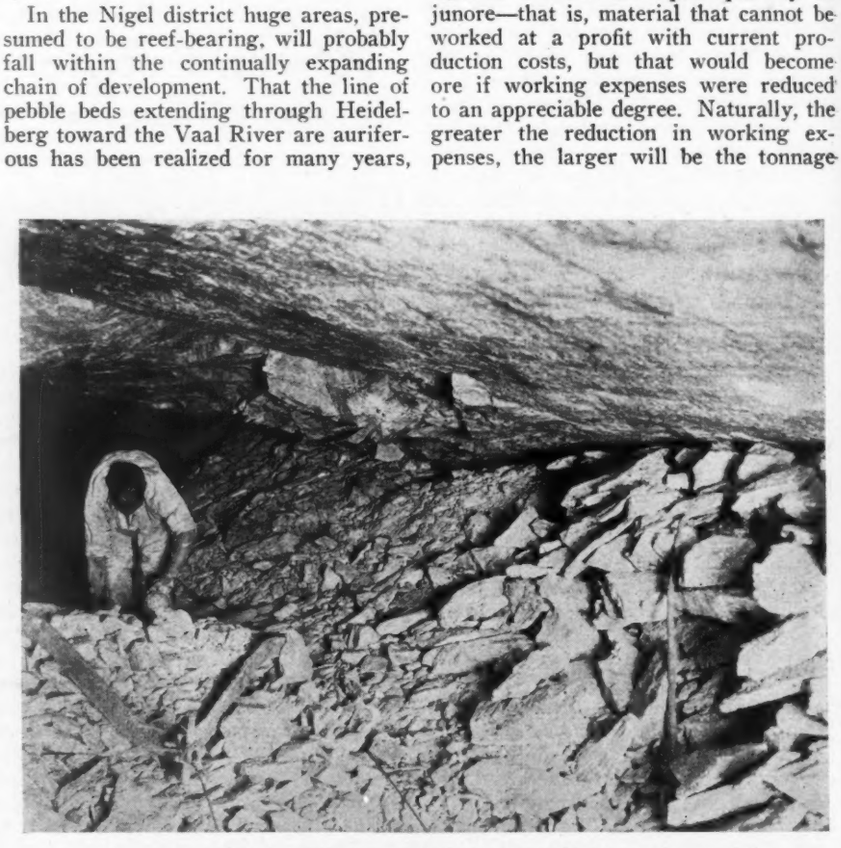
To the Far East Rand and to the probability of expanding that area South Africa must hereafter look for the main portion of the supply of gold which the world requires and demands. Two spearheads of development are now being driven out into what is still more or less *terra incognito*. One of these is the East Geduld property and the other, to the southeast, is Daggafontein. In each instance, preliminary development has been achieved by means of extending the headings in adjacent properties —from Geduld Proprietary in the case of East Geduld, and from Springs with regard to Daggafontein—into neighboring claims. Preliminary development operations having given satisfactory results, new vertical shafts are now being sunk at both mines. East of East Geduld is the huge Grootvlei area, controlled by Lewis & Marks. Plans are now under consideration for the opening of this holding, which was diamond drilled 25 years ago to prove the existence of the lower Witwatersrand system.

In the Nigel district huge areas, presumed to be reef-bearing, will probably fall within the continually expanding chain of development. That the line of pebble beds extending through Heidelberg toward the Vaal River are auriferous has been realized for many years, but all attempts that have so far been made to bring them under serious and consistent development have failed. The late W. A. Quince, formerly manager of Sub Nigel, was in London endeavoring to arrange for the financing of a large-scale scheme of exploitation of the reefs, shortly before his unfortunate accidental death at the Ariston mine.

Another possibility for extending the active area of the Witwatersrand gold field lies southwest of the Randfontein mine, in the properties formerly known as Western Rand Estates and now grouped under the title of Western Areas.

Still further afield, in the Klerksdorp district, immense tonnages of ore of debatable value are known. Some of these Klerksdorp properties have been worked in the past, but premature crushing and lack of financial resources have proved the main factors detrimental to success. If managed more effectively and adequately financed some, at any rate, of these outlying properties might be made to yield substantial profits.

At various times estimates based on the latest and most reliable data available have been put forward by numerous technical and economic authorities as to the ore reserves remaining in the Witwatersrand area. Naturally, there have been very broad variations in these estimates, but in the areas at present under active development there probably are not less than 500,000,000 tons of ore and an equal quantity of junore—that is, material that cannot be worked at a profit with current production costs, but that would become ore if working expenses were reduced to an appreciable degree. Naturally, the greater the reduction in working expenses, the larger will be the tonnage



A scraper at work in the Modder B mine, one of the higher grade properties on the Far East Rand

that is automatically transferred from junore to ore.

In addition to these tonnages in the Central Rand sections, an immense quantity of ore that is potentially profitable is indicated in the extensions of the Rand to the east and west of the areas now being exploited. The quantity and value of this tonnage are problematical, but in the course of time probably many millions of tons of ore located in these outlying extensions will be operated at a profit.

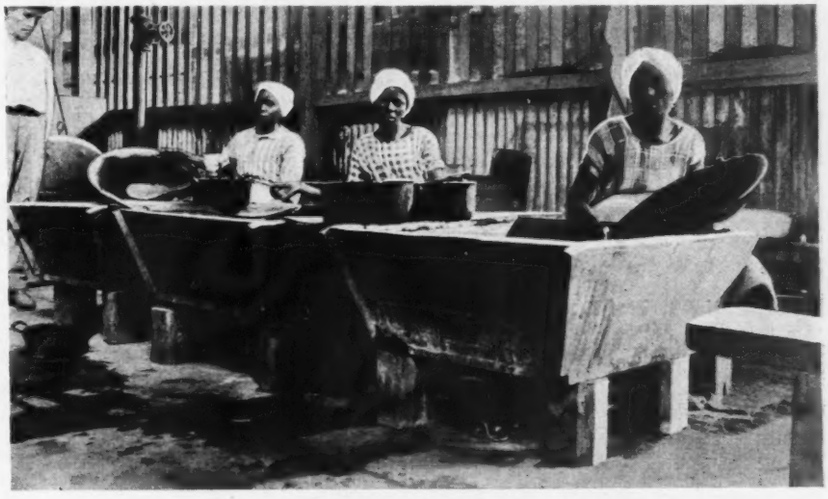
In the mines of the Witwatersrand, according to the latest estimates, about 90,000,000 tons of ore is now standing developed and available for stoping. Nearly 20 per cent of this tonnage is of an average assay value under 6 dwt. per ton; 34 per cent averages between 6 and 7 dwt.; 14 per cent has a value of between 7 and 8 dwt.; roughly 28 per cent assays between 8 and 9 dwt.; and the remaining 4.7 per cent, or 4,172,000 tons, has an average value of more than 9 dwt. per ton. Of the total of 90,000,000 tons, about 51,000,000 tons is in the Far East Rand section of the field.

In considering these figures, the reader must remember that many hypothetical factors must enter into them. No one can foresee the value of immense blocks into which not a single rock drill has as yet penetrated. The remarkable consistency of the banket deposits of the Witwatersrand, however, affords justification for anticipating that not less than 1,000,000,000 tons of ore remains to be extracted from the areas of the Witwatersrand now under exploitation and those which are known to be gold bearing. In the course of time probably the larger portion, if not all, of the tonnage having a value of 4 dwt. per ton and over will be worked. The demand for gold and the dependence of the Union of South Africa to such a large degree for its prosperity upon gold mining are the chief factors that apparently insure active development of the Rand banket beds over an area extending far beyond the confines of the present producing section.

Various problems will call for solution in achieving this intensification of development of the conglomerate beds. First and foremost, perhaps, is that of bettering health conditions at depths of 6,000 ft. and more—that is to say, of diminishing working temperatures and reducing humidity. Maintenance of the native labor supply is another cardinal consideration in the Rand's scale of operations. The organization of the industry has to date satisfactorily surmounted these and other problems and probably will continue to do so successfully. Given reasonably favorable working conditions, the Witwatersrand should be able to maintain production at slightly more than 10,000,000 oz. per annum for several years to come.

Passagem Mine Still Uses Batea in Gold Recovery

FOR the final washing of rich concentrate, the batea method is still employed at the Passagem gold mine, near Ouro Preto, State of Minas Geraes, Brazil. This mine was bought in 1884 by one of the companies of John Taylor, Ltd., and operated under the name of Ouro Preto Gold Mines, Ltd., of London. In 1926 the present Brazilian owners, a company head by Dr. Antonio Guimaraes, bought the property, now known as Minas de Passagem.



The batea washers at work in Passagem gold mine reduction works. On the extreme left is the expert, who has worked there more than thirty years.

Although very old, the batea method of separating is still used at Passagem because it is found more successful than any mechanical means in the final washing of the concentrates from the blankets, frue vanner and Diester table. Years of practice have given the native women washers remarkable dexterity in removing bits of iron ore, sand, and other waste from the gold by handling the batea with a circular sweep accompanied by side shakes. Through constant practice, they are able to maintain the gold at the top side of the batea while continually washing off the waste. To reduce the chance of the gold float escaping, the juice of a pounded herb—the local jurupeba plant (*Solanum paniculatum*)—is added to the water in the batea, making it somewhat soapy and preventing surface tension. The same effect may be produced by the juice of the maracuja plant (passion flower), commonly used by Brazilian batea workers.

The finished product after the use of the batea at Passagem is practically pure gold, which is heated to remove the moisture and taken to the assay office for weighing and refining. Of the three women washing in the Passagem reduction works, one has become expert from over thirty years' employment there at that work. She does the finest stages of the process. These women wear red baize aprons as a distinguishing badge, by which they are known throughout Ouro Preto.

■ ■ ■

Production and Development Statistics, Witwatersrand

Year	Tons Hoisted	Tons Milled	Development Work (Feet Driven)	Gold Output, Ounces
1921	26,909,856	23,437,196	585,649	7,930,700
1922	22,424,817	19,585,920	466,518	6,797,772
1923	31,230,109	26,765,126	771,282	8,915,815
1924	33,451,623	28,527,010	891,858	9,329,275
1925	33,965,627	28,659,217	903,719	9,341,049
1926	35,482,380	29,742,630	951,737	9,656,778
1927	35,590,174	29,397,985	1,004,950	9,715,015
1928	36,732,387	30,218,533	1,095,902	9,899,894
1929	37,559,489	30,741,854	1,110,548	9,979,106

Digest of Current Technical Literature

Selected from abstracts of articles in the leading technical periodicals, prepared by Engineering Index Service, American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

Ore Treatment: Flotation—Determination of Hydrogen-Ion Concentration in Ore Slimes. F. Prockat and H. Kirchberg. *Metall und Erz,* Vol. 27, No. 5, March 1, 1930.

HYDROGEN-ION measuring method is determined; electrometric measurement; electrode poisons; *pH* determination with indicators; details of Wulff colorimeter.—E.I.S., New York.

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Potash Mines and Mining: Scrapers — Scraper Winches and Scrapers, Their Design and Application in German Mines, With Special Regard to Potash Mines. K. Meyer. *Kali,* Vol. 24, Nos. 8, 9, and 10, April 15, May 1 and 15, 1930.

NOTES on scraper winches and electric motors; cables and rolls; loading platforms; use of scrapers in potash mines.—E.I.S., New York.

•

Limestone Mines and Mining: Kansas City, Mo.—Much Limestone in Kansas City Area Is Mined by Underground Methods. W. J. Brimacombe. *Pit and Quarry,* Vol. 20, No. 4, May 21, 1930.

OPERATIONS of Dietz Hill Development Company are described; plant was erected in 1928 and is equipped to handle capacity of 1,500 tons daily; equipment is illustrated and described.—E.I.S., New York.

•

Mine Ventilation: Fans—Reconstruction of a Mine Fan Based on Established Characteristics. R. Mulsow. *Glueckauf,* Vol. 66, No. 13, March 29, 1930.

TESTS were carried out on old ventilating installation and, based on results, characteristics of fan are derived; necessity of reconstruction of plant was made evident by this study and new installation gives far better economic results.—E.I.S., New York.

•

Lead-Zinc Ore Treatment: Germany—Preparation of Ore From German Bleischarley Mines. Patzschke. *Metall und Erz,* Vol. 27, No. 5, March 1, 1930.

THROUGH heavy oxidation of metosomatic deposits of this mine, but especially by subsequent penetration of iron pyrites, treatment of these Upper Silesian ores offers no insurmountable difficulties; methods of recovery and treatment are described and cost analysis is given.—E.I.S., New York.

•

Nickel Smelting: Russia—Production of Metallic Nickel From Ufaley Nickel Ores. A. A. Mironov. *Tsyvetniye Metalli,* No. 1, January, 1930.

REPORT on experimental runs made at Sverdlovsk Plant, following general scheme of Frankenstein nickel smelter, in Germany, as modified by N. N. Baraboshkin.—E.I.S., New York.

•

Non-Ferrous Metals: Cold Working—Cold Working of Lead, Tin, and Cadmium at Different Temperatures. A. Molnar. *Académie des Sciences—Comptes Rendus,* Vol. 190, No. 9, March 3, 1930.

COLD working of lead to 25-50 per cent at minus 40 to 75 deg. produces permanent increase in hardness, whereas at minus 40 to plus 50 deg. hardness returns to its original value at a rate which is greatest at higher temperatures; for tin and cadmium the effect is permanent below minus 20 and 40 deg., and the recovery is instantaneous at plus 50 and plus 25 deg.—E.I.S., New York.

•

Mines and Mining: Equipment, Steel—Use of Steel in Mining. R. Wueker. *Montanistische Rundschau,* Vol. 22, No. 6, March 16, 1930.

STATISTICAL, technical, and economic aspects are discussed.—E.I.S., New York.

•

Shaft Sinking: Germany — Chemical Sealing and Strengthening of Brick Shaft Lining. K. Buehrig. *Glueckauf,* Vol. 66, No. 18, May 3, 1930. See also translated abstract in *Iron and Coal Trades Rev.,* Vol. 120, No. 3246, May 16, 1930.

NOTES on double-solution process used at Toppolczan shaft of Castellengo coal mine in German Upper Silesia; rock, brickwork, or concrete is first impregnated with solution containing silicic acid; second solution seals.—E.I.S., New York.

•

Copper Refining: Electrolytic — Principles Underlying Calculation of Electrolytic Copper Refining Plants. F. Vogel. *Metall und Erz,* Vol. 27, No. 6, March 2, 1930.

FACTORS which should be considered in calculation of electrolytic plants include: chemical composition of raw material, quantities to be treated daily.—E.I.S., New York.

•

Silver Ore Treatment, Electrolytic — Energy Distribution in the Separation of Auriferous Silver. F. Vogel. *Metall und Erz,* Vol. 27, No. 8, 2d April issue, 1930.

AFTER introductory discussion of processes employed in recovery of rare metals, two most important processes for treatment of "gueldisch" are studied with respect to their energy requirements; losses are determined and limits of application defined; "gueldisch" is the German term given to rare metals (gold and silver) alloyed with copper.—E.I.S., New York.

•

Mine Ventilation: Fans—Tests of Mine Ventilation. L. Lahoussay. *Revue de Industrie Minérale,* No. 223, April 1, 1930.

ACCOUNT of tests and results of measurement of charge, depression, speed, and shaft power; evaluation of tests and construction of curves; conclusions.—E.I.S., New York.

•

Copper Mining Geology—Outlook for New Ore Reserves. A. Locke. *Pan-Am. Geologist,* Vol. 53, No. 4, May, 1930.

COMMENT on rising costs for ore discovery; improvement in methods is desirable; correlation of hidden ore and its leached equivalent on surface; discussion of example at Tyrone, N. M.; review of literature. Bibliography. Extracts from author's recently published treatise on "Leached Out-Crops as Guides to Copper Ores," Williams and Wilkins, Baltimore, to which reference may be made for fuller details.—E.I.S., New York.

•

Nickel-Smelting Plants: Russia—Projects of Aluminum and Nickel Metallurgical Plants. N. I. Berlin. *Tsyvetniye Metalli* (Moscow), No. 1, January, 1930.

FEATURES of Russian government project for establishing aluminum plant in proximity of Dnieper River hydro-electric development; 10,000 tons of aluminum per annum to be extracted from bauxites by method of Kuznetzov-Zhukovsky; preliminary plan of nickel smelter at Ufaley, in Ural, which is to produce 1,000 tons per annum from ore containing 3 per cent nickel.—E.I.S., New York.

•

Ore Treatment: Flotation — Pneumatic Machines for Ore Flotation. E. W. Mayer. *Revista Minera,* Vol. 81, No. 3212, April 16, 1930.

REVIEW of progress in flotation treatment of ores, with special description of pneumatic process machines of types used in large installations in United States; developed independently by Callow and MacIntosh, and later improved as Callow-MacIntosh machines.—E.I.S., New York.

•

Copper Metallurgy — Reverberatory Smelting of Copper-Oxide Ores to Matte. Saint Maurice. *Revue de Metallurgie,* Vol. 27, No. 4, April, 1930.

RESEARCH was undertaken with view to extending metallurgical process employed at Boléo for sulphide ore to treatment of oxides; sulphurizing agent and its chemical action; preliminary crucible treatment; method of calculating amount of sulphurizing agent required; oxidized ores with and without manganese.—E.I.S., New York.

•

Lead Smelting: Zinc Recovery — Dezincification of Lower Harz Lead Slag. G. Wenzel. *Metall und Erz,* Vol. 27, No. 10, May 2, 1930.

ORIGIN and composition of slags; significance of sulphur content; process of dezincification; comparison with Waelz volatilization process; limits of economy; mixed slags; description of dezincification plant at Oker, employing Pape process.—E.I.S., New York.

•

Graphite: Enrichment — Enrichment of Zavalye Graphite. B. A. Davidovich and A. A. Kireyev. *Mineralnoye Siryo,* Vol. 5, No. 1, January, 1930.

PRELIMINARY reports on research done by enrichment department of Institute of Applied Mineralogy of Russia, on concentration of coarse-flake graphite from Bug River basin in Ukrania; method of grinding; flotation reagents used; results of chemical, mineralogical, and petrographical analysis. (In Russian).—E.I.S., New York.

•

Gold Ore Treatment: Flotation—Flotation of Antimonial Ore From Wiluna. W. G. Clarke and B. H. Moore. *Chem. Eng. and Min. Rev.,* Vol. 22, No. 260, May 5, 1930.

ANTIMONY in flotation concentrates causes

difficulty in later roasting and cyanidation; investigations as to producing concentrates containing less than 1 per cent antimony; massive stibnite can be separated by hand picking; stibnite in ore can be floated without conditioning agent, after fine grinding with 0.06 lb. eucalyptus oil per ton of ore; 90 per cent of antimony can be eliminated from gold concentrate, with 90 per cent recovery of gold content of ore. Abstract from School of Mines of Western Australia, Bull., No. 5.—E.I.S., New York.

•

Dolomite Quarries and Quarrying: New York—Quarry Stripping Experience and Costs With Tractor Trucks. *Rock Products,* Vol. 34, No. 11, May 24, 1930.

NOTES on hauling problem; experience with tractors; comparative operating costs; savings effected. Based on information and data furnished by A. C. Neilson Company, industrial surveys, in collaboration with A. T. Neely, superintendent, Penfield plant, Dolomite Products Company.—E.I.S., New York.

•

Granite Quarries and Quarrying: Dust Hazard—The Silica Dust Hazard in the Granite Cutting Industry. L. R. Thompson and R. H. Britten. *Jl. of Indus. Hygiene,* Vol. 12, No. 4, April, 1930.

RESULTS of study of effect of silica dust on health of workers made in granite cutting plants in Barre, Vt.; factors influencing sickness rates; findings from physical examinations.—E.I.S., New York.

•

Limestone Quarries and Quarrying: Mergers — The Indiana Limestone Company—A Case of Study in Consolidation. H. P. Dutton. *Factory and Industrial Management,* Vol. 79, No. 6, June, 1930.

ADVANTAGES of consolidation illustrated by case of Indiana Limestone Company.—E.I.S., New York.

•

Ore Treatment: Flotation Reagents — Flotation Chemicals. E. W. Mayer. *Chemiker-Zeitung,* Vol. 54, Nos. 24 and 26, March 22 and 29, 1930.

NOTES on flotation reagents; collectors and frothers; addition reagents; conditioning, depressing, activating, modifying, toxic, and anti-toxic agents.—E.I.S., New York.

•

Limestone Mines and Mining: Illinois—Triangular Block Cut for Mining of Limestone Underground. C. H. Coale. *Concrete,* Vol. 36, No. 6, June, 1930.

DESCRIPTION of method of drilling and blasting in Vanport Limestone seam; kinds of dynamite used; calculating explosive charge; economies obtained from use of method.—E.I.S., New York.

•

Mines and Mining: Blasting — Newly Listed Electric Ignition Equipment. Vollmar. *Bergbau,* Vol. 43, No. 11, March 13, 1930.

BLASTING cartridges, electric ignitions, and ignition cables are affected by new code in Germany; details of ignitors, subdivided in bridge ignitors A and B, gap ignitors, and shunt ignitors.—E.I.S., New York.

•

Screens—Progress in Screening Technique. E. J. Ivers. *Metall und Erz,* Vol. 27, No. 8, April 2, 1930.

SIFTING machines and screen bottoms are stated to be in status of new development; review of improvements in perforated plates, screen cloths, and latticed screens.—E.I.S., New York.

Copper Smelting Plants — True Pyrite Smelting. A. J. Caddick. *Metal Industry* (London), Vol. 36, No. 22, May 30, 1930.

OPERATION records of two smelters with 16,000-ton burden not using any carbonaceous fuel except for blow-in.—E.I.S., New York.

Copper Ore Treatment: Flotation — Hydrogen-Ion Concentration of Flotation Slimes and Its Influence on Separation and Enrichment in the Case of Sulphide Copper Ores. F. Prockat and H. Kirchberg. *Metall und Erz,* Vol. 27, No. 5, March 1, 1930.

RESULTS of tests; influence of apparatus employed, flotation agents, and ores on hydrogen-ion concentration.—E.I.S., New York.

•

Electric Rectifiers: Mercury Arc — Mercury-Arc Rectifier Makes Bow in Anthracite Field. C. R. Seem. *Coal Age,* Vol. 35, No. 6, June, 1930.

NOTES on 275-kw. 275-volt machine being tried out at Storrs No. 3 anthracite coal mine of Glen Alden Coal Company, of Scranton, Pa.; day load of mine locomotives, coal-cutting machines, shaking conveyors, and pumps is carried by 500-kw. 275-volt rotary converter and rectifier takes entire load; wiring diagram; graphs of comparative efficiencies, power factor, and voltage characteristics.—E.I.S., New York.

•

Ore Treatment: Waelz Process — Improvements in Metallurgical Practice. O. Barth. *Zeit. fuer Angewandte Chemie,* Vol. 43, No. 12, March 22, 1930.

DESCRIPTION of Krupp Waelz process for volatilization of zinc, lead, tin, and other metals from ores, slags, and metallurgical intermediate products; characteristic of process lies in use of revolving tube furnace in which material is uniformly worked without melting and rolls itself slowly forward; name is derived from this process and not, as is often erroneously believed, from name of inventor.—E.I.S., New York.

•

Electrochemistry — New Developments in Applied Electrochemistry, With Special Reference to Large Installations for Aqueous and Viscous Electrolytes. G. Eger. *Elektrotechnische Zeit,* Vol. 51, Nos. 22 and 23, May 29 and June 5, 1930.

MODERN trend and present status in modern electrolytic practice of metals.—E.I.S., New York.

•

Dredges: Pumping Time — Pumping Time for Hopper Dredges. R. S. Thomas. *Military Engr.,* Vol. 22, No. 123, May-June, 1930.

STUDY of methods of determining economic pumping time; present method of economic load tests should be supplemented by study of load curve based on all available data.—E.I.S., New York.

•

Mine Ventilation—Witwatersrand Mine Ventilation. J. P. Rees. *S. African Eng.,* Vol. 41, No. 4, April, 1930.

REGULATION by which requirements have been met which are: supply of air chemically pure; mitigation and removal of danger from siliceous dust; supply of cool air to deep mines; and removal of dust and fumes produced by blasting.—E.I.S., New York.

•

Lead-Zinc Ore Treatment: Flotation, Tasmania—The Electrolytic Zinc Company's Concentrating Mill at Rosebery, Tasmania. H. Hey. *Chem. Eng. and Min. Rev.,* Vol. 22, No. 258, March, 1930.

PLANT will treat fine-grained intimately associated sulphides from Rosebery and Hercules Mount Read mines; ores are similar, but Hercules contains more lead and zinc and less iron; mill capacity 18 tons per hour; fine grinding, 90 per cent through 200-mesh I.M.M. screen; acid flotation circuit is not possible, because of large amount of pyrite; details of crushing and grinding sections, flotation equipment, and practice as tested for some years in pilot mill.—E.I.S., New York.

•

Mine Timber Preservation — Timber Treatment Opens Way to Substantial Savings in Mine Operating Costs. L. N. Thomas. *Coal Age,* Vol. 35, No. 6, June, 1930.

DESCRIPTION of plant and practice of Carbon Fuel Company at Carbon, W. Va.; unsatisfactory experience with creosote dipping led to investigation of chemical treating methods; advantages of Wolman salts; chart records; illustrations of equipment; form of operating report; cost data. —E.I.S., New York.

•

Copper Refining: Gold Recovery—Experimental Enrichment of Poor Gold Slimes in Anodic Furnaces. A. A. Bulakh. *Tzyvetniye Metalli,* No. 1, January, 1930.

REPORT on experimental runs made at Krassny Viborzhetz Metallurgical plant; slime obtained from electrolysis of converter copper contains from 4 to 5 per cent silver and gold and from 40 to 50 per cent copper sulphide.—E.I.S., New York.

•

Kaolin Mines and Mining: Germany—Kaolin Mining in Northwest Saxon Porphyry District. A. Laubenheimer. *Berichte der Deutschen Keramischen Gesellschaft,* Vol. 11, No. 4, April, 1930.

DETAILED account of mineralogical, geological, and other important problems of kaolin mining, and description of kaolin deposits in Saxony; possibilities of kaolin treatment; kaolin deposits of this district embrace 50 per cent of German kaolin mines. Bibliography.—E.I.S., New York.

•

Grinding Mills: Tube—Tube-Mill Drives. L. Thieme. *Tonindustrie-Zeitung,* Vol. 54, No. 41, May 22, 1930.

DEVELOPMENT of drive is traced from initial studies in 1890 to present time; "Centra" compound drive, developed six years ago by Krupp, is believed to be superior to any other gear drive; driving power is transmitted from electric motor over precision gear by means of coupling spindle centrally to mill drum.—E.I.S., New York.

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Brass Foundry Practice — Melting of Sound Brass Castings. M. Schied. *Giesserei-Zeitung,* Vol. 27, No. 11, June 1, 1930.

BASED on practical experience, it is shown how unsound castings result from faulty melting practice.—E.I.S., New York.

•

Zinc Ore Treatment: Roasting—On the Roasting of Zinc Ores. Y. Ogawa. *Tohoku Imperial Univ.—Tech. Reports,* Vol. 9, No. 2, 1930.

MECHANISM of phenomena of roasting has been investigated by observing continuously with Honda's thermo-balance change in weight on clean blende during process; effects due to size of grains were investigated not only for collection of sifted particles as whole but also for single grains of different diameters specially prepared in form of spheres.—E.I.S., New York.

New Publications

SCIENTIFIC FUNDAMENTALS OF GRAVITY CONCENTRATION. *By Josef Finkey, E. M., Professor of Ore Dressing, School of Mines, Sapron, Hungary. Translated into English by C. O. Anderson and M. H. Griffitts. Bulletin, School of Mines and Metallurgy, University of Missouri, Rolla, Mo. Price $1.*

AN EXCELLENT translation of Josef Finkey's "The Scientific Fundamentals of Gravity Concentration" is now made available. It gives the ore-dressing profession the outstanding treatise on gravity concentration in recent years. The original treatise, published in German in 1924, was ably reviewed in *Engineering and Mining Journal-Press* of Aug. 30, 1924, by Dr. Rudolf Gahl, who quoted the gist of the author's preface:

"The existing textbooks of ore dressing, with the possible exception of Rittinger's now antiquated book, deal essentially with ore-dressing machines and auxiliary apparatus in a descriptive way and skip over the physics of ore-dressing processes. A study of the physical fundamentals is not only necessary to the man who wants to understand the principles of the processes and the manner in which the machines and apparatus work, but particularly to the practical operator who is anxious to obtain the highest efficiency of his machines, both from the technical and commercial standpoint."

Professor Finkey's treatise is confined largely to a mathematical exposition of gravity concentration processes, and he utilizes the previous experimental works of Richards, Stokes, Wagoner, Rittinger, and others to interpret his deductions. Of necessity, Professor Finkey employs higher mathematics throughout his work, and he uses hyperbolic functions to express his various conclusions. He derives equations for the mechanics of gravity concentration including the dynamic action of a stream of water against solids of various shapes and conditions, the free fall of spherical solid bodies in still water, the motion of a spherical body in a vertical stream of water, and the movement of a spherical body in a stream of water flowing over an inclined plane. These basic equations are utilized for deducting the principles of screening and classifying according to settling rates and for the more complex processes of jigging and tabling. Because of the complexity of some of the equations, Professor Finkey has derived simplified forms, which hold for practical operation.

In addition to the derivation of fundamental equations, the treatise contains observations and conclusions regarding gravity concentration practice, particularly European practice, which should be of value to the operator.

This translation of Josef Finkey's treatise will find favor both in the operation and teaching field of ore dressing. The translators are to be praised for their efforts, and the U. S. Bureau of Mines, in co-operation with the Missouri School of Mines, for sponsoring it. It will take its place among the classics of ore dressing, along with the works of Rittenger and Richards.

J. R. CUDWORTH.

■

GEOPHYSICAL METHODS OF PROSPECTING, PRINCIPLES AND RECENT SUCCESSES. *By C. A. Heiland. Colorado School of Mines Quarterly, Vol. 24, No. 1; Golden, Colo.*

THE purpose of this pamphlet is to supply the need for a brief perspective of geophysical fundamentals and a discussion of the types of problems to which the methods have been applied. In considering the limitations of geophysical prospecting, Dr. Heiland emphasizes a thing too often overlooked by mining men in the early days of electrical prospecting; namely, any geophysical prospecting method discovers only a certain physical effect, not a particular deposit, and the necessity of correlating this with the geological data is absolutely imperative.

Geophysical methods may be divided into two classes, those studying the direct effect of a natural field of force, and those employing an externally applied field. The understanding of the subdivisions in each of these two classes is greatly facilitated by the very illuminating tabulation drawn up by Dr. Heiland. In the columns are listed the field studied, the apparatus used, the particular component of the field which is the subject of measurement, the physical effect of the disturbance, and, finally, the application.

The first half of the book is devoted to the "Natural Field" methods, and opens with an account of those of the gravity type. The employment of the torsion balance in salt-dome work is discussed; likewise its use in structural studies and in mining. A list of places where the balance has been used is given. The same general plan is followed in the section on magnetic work. Numerous surveys are described and illustrated, and there is a table of important oil localities which have been magnetically surveyed. Brief mention is made of the radioactive and geothermal methods.

The last half of the book deals with the methods using externally applied fields of force, and commences with the seismic. Work on salt domes, uplifts, and faults is mentioned. The electrical methods, next considered, Dr. Heiland divides in two classes: the self-potential, or spontaneous polarization method, and the methods employing an artificially applied current, field, or radiation. A table further clarifies this principle. As a matter of fact, the spontaneous polarization method really belongs with those methods of investigating a natural field of force, but can most conveniently be studied along with the other electrical methods. The principles and technique developed by Prof. Conrad Schlumberger are detailed. Methods used for determining the electrical resistances of the hidden rocks are described.

Lundberg's equipotential line method is also described, in which alternating current is used instead of direct. Dr. Heiland also dips into the controversial subject of the relative advantages and disadvantages of the use of direct versus alternating current. Elbof's method comes in for brief mention, and the author calls attention to conflicting reports as to its success. The electromagnetic methods of Lundberg and Sundberg are described; likewise the Radiore method.

The statistical section is valuable, as it gives a list of consulting geophysical companies and individuals and of firms making geophysical instruments. There is also a list of recent geophysical activities of oil, mining, and consulting companies in North America, and another of all places where geophysical prospecting has been done.

The outline maps on which the areas are blacked in where given types of geophysical exploration have been employed provide striking evidence of the spreading activity in this new science.

If any criticism is to be directed against this useful book, it is that there is evidence that the material was probably put together too hastily to do justice to the breadth of subject treated. As a result, some minor errors have crept in, but they are not of grave importance.

Dr. Heiland's work can be of great use to the engineer or geologist desiring to learn something of the why and how of geophysics, and where and when the different methods can be, and have been, used. To the geophysicist it is of value in summarizing and bringing together scattered data on the actual field applications of all the methods. It is a book to be studied, and then kept for reference, by anyone professing to be in touch with developments in geophysical prospecting.

SHERWIN F. KELLY.

INTRODUCTORY ECONOMIC GEOLOGY. *By W. A. Tarr. New York: McGraw-Hill Book Company. Pp. 664. Price $5.*

AFTER years of teaching the subject to those who for the most part have had only an introductory course in geology, the author now seeks a wider circle of students in presenting what he calls a general picture of the earth materials used by man. The text is so simply arranged and written that the layman will have no difficulty in its use. A major purpose has been to make the book interesting and instructive.

The book, like Gaul, is divided into three parts. The first treats of the history and origin of the materials dealt with, and in not too technical a way. Part II, entitled "Metallic Earth Materials," takes up in successive chapters the subjects of iron, ferro-alloy metals, copper, lead and zinc, gold and silver, tin, aluminum, and the minor metals. Part III deals with the non-metallics. The subjects are, respectively, coal, petroleum and natural gas, structural materials, materials used chemically, and materials of miscellaneous use. To aid the student, the author gives selected readings at the end of each chapter.

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MINING INDUSTRY OF IDAHO, 1929. *Obtainable free from the State Mine Inspector's Office, Boise, Idaho. Pp. 290.*

Stewart Campbell has given the mining industry another edition of his outstanding reference book on mining activities during the last year in Idaho. Detailed information is given about every known property, and the work of many individuals in developing claims is summarized. Several special articles are a feature, including: "Artificial Sunshine for Mine Workers," by Stanly A. Easton: "New Hoists of Hecla Mining Company," by A. C. Stevenson; "Hercules Custom Mill." by Henry Lawrence Day; and "Inclined Top-Slice Stoping Method," by E. M. Norris, describing the methods, used at the phosphate mine of the Anaconda company at Conda, Idaho.

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GERMAN-ENGLISH TECHNICAL AND SCIENTIFIC DICTIONARY. *By A. Webel. New York: E. P. Dutton & Company. Pp. 887. Price $10.50.*

Those who have felt the need of a German-English technical and scientific dictionary will welcome this book. It contains about 75,000 references, with a mass of technical data, chemical formulas, and the most up-to-date terms in modern science and engineering. A special feature of the volume is that it is keyed throughout for cabling by a simple system devised by the author. An appendix contains an exhaustive list of abbreviations and symbols and several thousand botanical terms in Latin, English, and German.

Comment and Criticism

Pressure Zones and Metal Deposition

To the Editor of "E.&M.J.":

Referring to Mr. Lawrence B. Wright's interesting observations dealing with the influence of pressure zones on metal deposition, published in the June 23 issue of *Engineering and Mining Journal,* several points invite some contradictory discussion.

Assuming that the pressure-zone phenomena exemplified by the gold deposits cited are equally applicable to base-metal deposition, and that the other factors governing location and value of syngenetic metalliferous deposits could be segregated and given their proper degree of influence, I am at a loss to explain the impoverishment of values in zones of relatively greater pressures in many deposits that have come under my observation. In using the term "maximum pressure zone" I am assuming this to mean relative pressure and to be expressed by the zone of minimum cross-section.

Several lead-zinc replacement deposits in the Cretaceous limestone and dolomite of Chihuahua and Coahuila exist in which the degree of concentration of base-metal values is almost in direct proportion to the widening of wall rock in two dimensions along the strike of the ore zone. Could it be that the effects of favorable beds, relative permeability, or structural relations have nullified any influence caused by a relatively higher wall-rock pressure? This condition exists in several horizons at Santa Eulalia, at Almoloya, and elsewhere.

Another contradictory case can be found in the low-grade copper-zinc deposits in the Pre-Cambrian district of Manitoba, where horses and large inclusions of barren schist have narrowed or branched an ore lens. At these locations the ore is often leanest.

Regarding deposition in the purely geophysical sense: A greater degree of concentration would appear to exist at loci of minimized pressures and temperatures, inasmuch as the metal-sulphide components of a gangue are more soluble than are their commonly associated gangue minerals, particularly in the case of an acid gangue.

In conclusion, I would like to state that these contradictory examples are not presented with the idea of lessening the applicability of the valuable principle suggested by Mr. Wright, but rather to invite discussion and establish the limitations, if possible, of this important factor.

A. I. RODRIGUEZ.

Cresent Mills, Calif.

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Stabilization

To the Editor of "E.&M.J.":

I have read with considerable interest the articles by J. R. Finlay and Paul T. Bruhl in your issue of June 7. I certainly hope such articles will arouse an interest, and induce men of power and ability to think along these lines. Most of our rich and influential men are, in my opinion, sympathetic and do not like to see unemployment and suffering from periods of depression. At present they seem to derive pleasure from the competition for power, which necessitates the continued accumulation of wealth. If these same men would concentrate on the problem of unemployment and *real stability,* the contest between them to this end would be just as interesting and fascinating and afford a greater feeling of satisfaction.

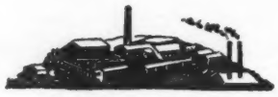
In this age, many men of brains and power appear to have an ambition to see how many directorships they can fill, not realizing, seemingly, other responsibilities than to make money. They do not look deep enough into the welfare of the country as a whole so far as the real stability of business is concerned, and, therefore, the elimination of depression and unemployment; nor do they make a sufficiently broad study of tariff, taxes, and other governmental agencies. There seems to be a tendency on the part of such men to control and concentrate everything to a point where reaction sets in and they are compelled to tighten up, thereby forcing a period of depression and unemployment.

It is true that it is the duty of the directors to look after the interest of the stockholders, but the stockholders are the citizens of the country, and they are affected in varying degrees by depression and unemployment periods. Leaders in industry should think seriously in terms of *real stability* which will effect the welfare of the public in general.

E. M. JOHNSON.

Henryetta, Okla.

INDUSTRIAL PROGRESS



Rotary Dryer of Special Design Has Wide Field of Application

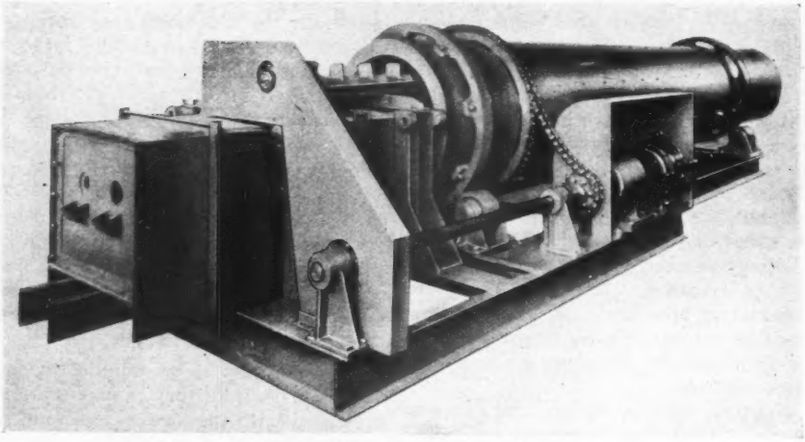


Fig. 1—Miller dryer used for treating flotation concentrates

Fig. 2—Discharge end of dryer, showing lifters

AN EFFICIENT rotary dryer, known as the Miller dryer, is being applied successfully in the southeast Missouri district for drying lead flotation concentrate, as well as for drying sand for use on surface and underground haulage lines, and coke for smelting purposes. A unit is also being used to dry bauxite at the plant of the Dixie Bauxite Company, situated at Sweet Home, Ark. Some of the special features of the dryer, which is shown in Fig. 1, are: (1) Cost of operation is low, owing to low fuel consumption and low power requirements; (2) use of compressed air is unnecessary, inasmuch as low-pressure burners are employed; (3) the unit is self-contained and occupies a relatively small space; (4) installation expense is almost negligible.

In treating lead flotation concentrates, feed to the dryer consists of the product from vacuum filters that contains 12 to 14 per cent moisture. This moisture content is reduced to 6 per cent by the dryer, the rate of treatment being about 5 tons per hour. Fuel consumption averages 10 gal. of fuel oil per hour.

The drum of the dryer, which is 36 in. in diameter and 20 ft. long, is made of sheet metal and has an inclination of ½ in. per foot. The frame consists of structural members. Both the drum and the frame are electrically welded throughout, no rivets being used in their construction. Eight sheet-steel lifters, as shown in Fig. 2, are mounted on the interior surface of the drum. These carry the material to the top of the drum, and then drop it down through the heated gases. Dry material on the lifters passes through 1½-in. circular holes onto the drum surface, along which it travels to the discharge end. The lifters are bolted to the drum, and can therefore be readily replaced.

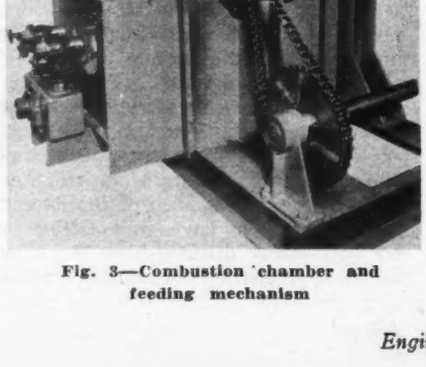


Fig. 3—Combustion chamber and feeding mechanism

The feeding mechanism, which is placed directly above the combustion chamber (see Fig. 3), consists of a double-screw conveyor, with broken flights. This type of feeder was designed especially to handle the wet, sticky material recovered by the flotation process. The speed of rotation of the feeder is 65 r.p.m. Both the drum and feeder are driven through a gear reducer and sprockets by a 7½-hp. motor. The drum is rotated at a speed of 6 r.p.m. The Miller dryer is manufactured by the Mines Equipment Company, of St. Louis.

■

Lubricating the Power Shovel

Correct lubrication is most important where the excavating machine is concerned. By it are avoided many stoppages that might otherwise occur, sometimes tying the job up completely. For this reason the average manufacturer takes pains to give the customer proper instruction. The practice of one of the principal builders is typical. Detailed printed instructions are given at the time of purchase. Brass plates attached to the various parts call attention to the constant need of supplying lubrication. This builder refrains from recommending a specific make of lubricant, there being several of approximately equal value and the matter of selection being something, he feels, that is best left to the customer. The designs are made with a view to permitting the use of standard lubricants, so there is no need for special varieties that may be available in only one brand.

For slow-moving shafts and where heavy loads are met a good grade of cup grease is customarily used. On shafts of higher speed the bearings are customarily designed for oil-ring or flooded lubrication, in which cases a light grade of oil is specified. On this class of bearing a pressure fitting is still used in many installations, a good cup grease being recommended. For gears, racking, handle, and cables a good grade of gear compound is recommended.

Directions with regard to lubrication of the electrical equipment on a shovel are usually of a general sort, because of the widely varying conditions under

which the excavator may work. For example, as regards the roller bearings on motor-generator sets, it is specified only that the grease used should be free from acid, of uniform quality, and not likely to separate under very severe churning action.

When equipment has been damaged by faulty lubrication, a company manufacturing electrical equipment for shovels, says: "We have no doubt that a considerable number of such cases exist, but usually they do not come to our attention as such, inasmuch as users are inclined to feel that the trouble is due to defects in the apparatus itself rather than to their own misuse of it. After a bearing is ruined, it is rather difficult to prove just what was the cause. We have in mind a case where an operator was having trouble with the bearings of a motor-generator set on a shovel. Inspection disclosed that the can containing the grease for the bearings was allowed to stand aboard the shovel without a cover, so that rock dust had a chance to settle in it. Trouble due to the lubrication is more often caused by neglecting lubrication entirely or getting foreign matter into the bearings than by having the wrong grade of lubricant. In general, if a bearing is correct in design and application, it should not be necessary to draw an exceedingly fine line as to the grade and quality of lubricant."

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New Process Rubber Displays Unusual Wearing Qualities

SPEAKING of covers for James sand tables, the manager of a large open-pit mine in Malaya says that the new rubber, made by the Wilkinson process and sold under the name of "Linatex" by the Wilkinson Process Rubber Sales Corporation, Chicago (described in *E.&M.J.*, March 8, 1930), is proving most satisfactory. The first cost, as compared with ordinary linoleum, is higher. In the tropics, however, the life of a linoleum cover is short—about six months or so—because of blistering or cracking. Apparently the rubber will outlast several timber decks. The cover for table surfaces has other marked advantages also. The pulp is free and mobile on it. The heavier particles have not the same tendency to cling to its surface as with linoleum. Consequently, better separation and concentration are effected. The gangue is quickly brought to the top of the table and travels there freely. Thus, the capacity of the table is also much increased. A Linatex-covered table will concentrate 22 per cent more black tin than one covered with linoleum, and the flood tailing runs lower in tin.

A tin dredge in Malaya operates to a depth of 40 ft., bottoming to limestone pinnacles, which are chipped off by the buckets in pieces comprising up to 200 lb. in weight. The stone chute which disposes of this material was lined with castings of white iron, 2½ in. thick at the point of greatest thickness, tapering off toward the side of the chute. The average life of service was only two months per set of liners. To renew the liners, an average of three days' stoppage of the dredge was necessary. Each minute's stoppage represented a loss of about 3s. A Linatex chute liner was installed, constructed in one piece, suitably thickened at the point where greatest service was required. The chute casing was drilled, to accommodate the bolts for the fixing straps, while the dredge was running, and the rubber quickly installed. After one year and seven months, the liner showed no signs of deterioration. It was 1½ in. thick at its thickest point. Advantages in this application are (1) saving in weight, the liner being less than one-tenth the weight of the white-iron liner; (2) longer life, it having nearly ten times the life of the white iron without sign of wear; (3) saving in installation cost; and (4) reduction in stoppages necessary to effect replacement.

THE EQUIPMENT REVIEW

A variety of welding equipment has been recently introduced by various manufacturers. Westinghouse has brought out the so-called "Flex-Arc" welding electrode, a general-purpose steel-welding electrode evolved by extensive experimental and development work conducted in actual welding practice. These electrodes are now used for welding the 2,000 tons of steel fabricated monthly in Westinghouse shops. To insure absolute uniformity, the company states, each coil of wire is arc-tested prior to straightening and cutting, and all processes from steel to bundled wire are under proper supervision to assure quality and uniformity. Welds made by the electrodes are said to be easily machined and free from slag, oxidation, and gas inclusions. High tensile strengths are consistently obtained without special skill on the part of the operator. The electrodes are carried in the following sizes: $\frac{1}{16}$, $\frac{5}{32}$, $\frac{1}{8}$, $\frac{5}{32}$, $\frac{7}{32}$, and $\frac{1}{4}$ in.

A new welding machine rated at 600 amp. has been introduced by Lincoln Electric Company, Cleveland, Ohio. This is said to have been developed to meet a demand for higher welding current to be used with metallic and carbon electrodes of large size. It may be had in the portable or stationary truck type. It is a motor-driven, single-operator, variable-voltage machine, with a current range of 180 to 750 amp. Motor and generator are direct-connected. Voltage and amperage can be read on one dial.

For small shops using welding, two manifolds of small capacity have been introduced by Oxweld Acetylene Company, New York. Where it is necessary to have a number of welding stations and the consumption of gases is not large enough to warrant installation of an acetylene generator and a large oxygen manifold, these small manifolds, it is said, will prove an effective means of having a piped supply of gases.

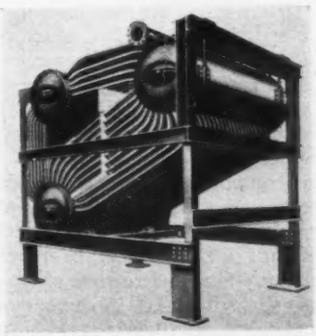
Controlling the Melting Pot

General Electric has announced a quartz-rod thermostat for controlling the temperature of soft-metal melting pots for use with lead, tin, babbitt, and solder. This is said to be inexpensive and accurate. It consists of an inclosed switch and a nickel-chrome-iron tube extending from its base and surrounding a steel piston and quartz rod. The thermostat has a temperature range of 450 to 950 deg. F. and will control temperatures to within plus or minus 14 deg. F. of its setting. The contacts will carry any current necessary to operate any standard automatic control panel.

For Users of Small Boilers

Adapting a three-drum boiler introduced some years ago, the Erie City Iron Works, Erie, Pa., has recently developed a new series of three-drum boilers ranging in size from 80 hp. up, for steam working pressures up to 350 lb. The new series embodies most of the features of the earlier models, but the design has been refined in detail to economize space.

The quality of producing slightly superheated steam is secured in this low-headroom boiler by use of a horizontal steam header, which, as shown in the cut, is connected to the rear steam drum by a number of superheating tubes. From the end of this header slightly superheated steam is discharged into the main steam line horizontally, an arrangement that reduces the headroom considerably over that required for the conventional top seam outlet. Another

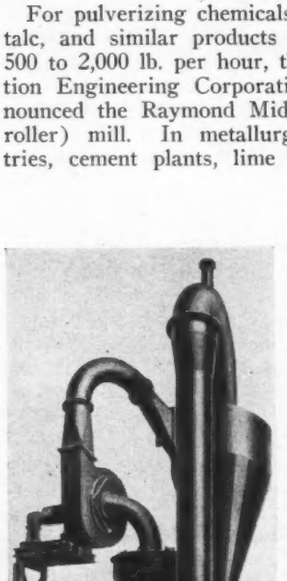


This steam-drum boiler, built in capacities from 80 hp. up and for pressures up to 350 lb., is designed to economize space

innovation is the elimination of the customary rear brick wall and the substitution of well-insulated removable plates. This feature permits easy access to the entire rear of the boiler. The baffles, moreover, are so arranged as gradually to lower the temperature of the hot gases until in the last pass an insulated steel plate rear wall is entirely adequate and obviously an economy.

A Small Pulverizing Mill

For pulverizing chemicals, limestone, talc, and similar products at rates of 500 to 2,000 lb. per hour, the Combustion Engineering Corporation has announced the Raymond Midget (No. 1 roller) mill. In metallurgical industries, cement plants, lime plants, and



A small roller mill for pulverizing soft materials

power plants, where powdered coal is used, this is said to be suitable for direct firing of furnaces, kilns, or other heating units. For grinding coal, its capacity may be varied from 1,000 to 4,000 lb. per hour.

Resistance Principle in Brazing

General Electric has developed a new line of electric brazing equipment of general industrial application. Methods and equipment are simple and inexpensive and have advantages over other methods of joining metals. Brazing is effected by heat generated by flow of electricity through carbon blocks. These offer high resistance to the current, producing correspondingly high heat. Small pressure is needed to complete the joint. The equipment consists of a transformer, a foot switch, and tongs for holding the blocks and the wood. The size of the various parts depends on that of work to be handled. A typical equipment involves a 5-kva. transformer weighing 45 lb. and having a 220-volt primary and 8-volt secondary.

Parts to be brazed are either designed with flat surfaces or flattened before brazing. After the work is clamped in the tongs, flux is added and the current is applied by pressing the foot switch. When the flux melts, the brazing alloy is held against the hot metal until the alloy flows into the joint by capillary attraction. During this process, the hot alloy dissolves a thin film of the metal surfaces, forming a new alloy rich in copper and with a higher melting point than the original. Advantages claimed are that less time is required, brazing is less expensive, and the conductivity, mechanical strength, and durability are higher than those of the lead joint.

New Speed Reducers

Some new speed reducers (Types S11 and DH) have been developed by the Nuttall Division of the Westinghouse company. These are standard single- and double-reduction units for use in general industrial and mining operations. They are of the non-planetary design with shafts arranged in a horizontal plane, and have either right- or left-hand assembly as desired. Both types are made in twelve sizes, providing a total of 28 standard reduction ratios ranging from 2.82:1 to 70.5:1 and having capacities of 1 to 635 hp. In the Type SH unit, the efficiency at full load is 98 to 99 per cent and in Type DH, 96 to 98 per cent. These reducers are conservatively rated on the basis of torque to be transmitted in continuous service, with ample allowance for 100 per cent over-load occurring at starting and momentarily during operation.

Automatic Switching for Synchronous Converters

Use of a copper-oxide rectifier in place of the field-flashing motor-generator set features a new design of automatic switching equipment for synchronous converters in mine service, announced by General Electric. The rectifier is connected to the a.c. power supply, providing a definite source of power at correct polarity with which to flash the field. The field-flashing contactor and the main field contactors are still used. The rectifier is very small and is mounted on the back of the starting and running panel. Its use eliminates some of the difficulties had with a motor-generator set.

The equipment as a whole provides protection to the substation equipment in the event of the following abnormal conditions: a.c. and d.c. overcurrent; a.c. undervoltage and reverse phase; d.c. reverse polarity, d.c. reverse power; incomplete start; overheated bearings and windings; single-phase or unbalanced-phase currents; overspeed, and wrong brush position.

BULLETINS

Flotation—Denver Equipment Company, Denver, Colo. Bulletin No. 2901, results in modern flotation with the "Sub-A" (Fahrenwald) flotation machine.

Centrifugal Pumps—Gould Pumps, Inc., Seneca Falls, N. Y. Bulletin No. 201, selection charts with complete description of horizontally split, multistage centrifugal pumps.

Automatic Pressure-Control—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-1162, describing CR2922-B1 pressure governor.

Power Transmission — Worthington Pump & Machinery Corporation, Harrison, N. J. Bulletin No. L-400, multi-V-drive.

Thickeners—Genter Thickener Company, 159 Pierpont St., Salt Lake City, Utah. Bulletin No. 4, a filter-thickener.

A New Silicon Bronze—Bridgeport Brass Company, Bridgeport, Conn. Book on Duronze.

Centrifugal Blowers and Compressors—Elliott Company, Pittsburgh, Pa. Bulletins P 4-5 on types M, S, and O.

New Electric Catalog—General Electric Company, Schenectady, N. Y. No. GEA-600A.

Heat-Treatment — General Electric Company, Schenectady, N. Y. Bulletin No. GEA-1174A, describing conveyor furnace mesh-belt Type RRT.

Non-Metallic Gears and Blanks—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-818A.

Electrical Control—General Electric Company, Schenectady, N. Y. Catalog No. GEA-606B.

Electric Flow Meters—Brown Instrument Company, Philadelphia, Pa. Book of instructions.

Electric Heat—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-104A, describes cartridge-type electric heating units.

Marine Boilers—James Leffel & Company, Springfield, Ohio. Bulletin No. 216, Scotch marine boilers and steam engines.

Flotation — Ruth Company, Denver, Colo. Mechanical specifications for gradient flotation.

Motor-Generator Sets—Reliance Electric & Engineering Company, Ivanhoe Road, Cleveland, Ohio. Bulletin No. 500.

Motors — Reliance Electric & Engineering Company, Ivanhoe Road, Cleveland, Ohio. Bulletin No. 108. Across-the-line-motors with ball bearings for two and three-phase a.c. circuits.

Unit Heaters—American Blower Corporation. Detroit, Mich. Bulletin No. 9218.

Ball Mills—American Ball Mill Company, Patterson Building, Denver, Colo. Catalog on boltless lined ball mills for wet or dry grinding.

Screw Conveyor Drives—H. W. Caldwell & Son Company, 2410 West 18th St., Chicago. Book No. 1191.

Instruments for Thermal Studies—R. Y. Ferner Company, Investment Building, Washington, D. C., representatives in United States and Canada for Chevenard equipment, developed in laboratory of Acieries d'Imphy, France. Catalog D-1. Industrial thermal analysers and differential dilatometers for studies of steel alloys and various materials such as refractories.

Personal Notes

Dr. **L. D. Ricketts,** accompanied by Mrs. Ricketts, will sail early in September for an extended tour through Europe.

The Hon. **W. A. Gordon,** K.C., of Haileybury, Ont., has been appointed Minister of Mines of Canada.

Roy H. Elliot, mining engineer, has established his office in the Hobart Building, San Francisco.

Milnor Roberts, dean of the College of Mining, University of Washington, has returned to Seattle after a professional and vacation trip to eastern states.

T. H. O'Brien, general manager of Inspiration Consolidated Copper, is a delegate to the Pan-American Reciprocal Trade Conference at Sacramento, Calif., which opens on Aug. 25.

John Van Nostrand Dorr sailed from New York for Europe on Aug. 8, to visit his associates in London, Paris, and Berlin. He plans to return about Oct. 1.

M. L. Savage, who recently resigned as manager of the Jack Waite mine, is developing a group of claims in Montana, near the Coeur d'Alene district.

J. H. Hensley, Jr., assistant manager of Miami Copper, at Miami, Ariz., with Mrs. Hensley, has returned from a vacation trip to Michigan.

R. S. Dening, formerly general manager of Huronian Belt, has joined the staff of British Securities, with headquarters at Toronto.

John L. Dynan has resigned as mine manager of Gold Hill Development, at Round Mountain, Nev., and is now in San Francisco.

L. F. Hilton, mining engineer with Pahang Consolidated, which operates lode tin mines in Malaya, is on furlough in Australia.

R. L. Agassiz, chairman of the board of directors of Calumet & Hecla Consolidated, returned recently to Boston after a visit at the properties of the company in the Michigan copper district.

A. D. Hughes has recently returned to New York from Bahia, Brazil, where he has been resident manager for the Bahia Corporation since the initiation of that company's diamond-mining operations.

W. S. Boyd, of San Francisco, formerly assistant managing director of Nevada Consolidated and Utah Copper, has been appointed vice-president and managing director of both companies.

John G. Marzel, Wyoming State Geologist, announces that the Association of American State Geologists will hold its annual field conference in Wyoming and Montana on Aug. 24-29.

F. Ward Paine, of Boston, vice-president and treasurer of Copper Range, is visiting the properties of the company in Houghton and Ontonagon counties, in the Michigan copper district.

A. O. Hayes, professor of geology at Rutgers University, is making a visit to the Portland Canal district of British Columbia, which he assisted in mapping about sixteen years ago.

Corey C. Brayton, mining engineer with American Manganese Steel, with headquarters at Oakland, Calif., has returned from a trip to South American mining districts.

W. C. Aitkenhead, after spending a year at Odda, Norway, with Det Norske Zinkkompani, left recently for Moscow, U.S.S.R., where he will join the staff of **A. E. Wheeler.**

J. V. N. DORR

H. D. Bemis, mill superintendent at the Pecos property of American Metal, which is located at Glorieta, N. M., is now in Concepcion del Oro, Zacatecas, Mexico.

W. Mont Ferry and **J. E. Cosgriff** have been appointed delegates from Utah to represent the silver-mining industry at the Pan-American Reciprocal Trade Conference.

P. G. Beckett, vice-president and general manager of the Phelps Dodge Corporation, at Douglas, Ariz., will address the members of the mining section of the National Safety Council on Sept. 30, at Pittsburgh, Pa., on the subject of "Fundamental Requirements in Successful Accident Prevention Work."

S. Ward Haas returned recently via Japan from the Belgian Congo, where for four years he was representative of **A. E. Wheeler,** consulting engineer, at the construction of the Union Minière copper leaching and refining plant. His address will be 17 East Clapier St., Germantown, Pa.

Norman Smith is doing independent research work at Waverly, Mass., on the general theory of ore deposition. He has just completed thirteen months at Flin Flon, Man., organizing a geological department for Hudson Bay Mining & Smelting.

D. D. Homer, general manager of Minas de Matahambre, Cuban copper producer, is in the United States on vacation. **R. H. Cromwell,** assistant general manager of Minas de Matahambre, is returning to Cuba after several weeks in the United States, during which he made a trip through the mining districts of the West.

Ralph Parker, for the last two years superintendent of the Creighton mine of International Nickel, at Creighton, Ont., has been appointed superintendent of the Frood mine of the same company, at Copper Cliff, Ont. He succeeds **George S. Helmrich,** who has resigned. **S. J. Kidder** takes Mr. Parker's place as superintendent at Creighton.

Dr. **John Wellington Finch,** mining engineer, of Denver, Colo., has been appointed dean of the School of Mines of the University of Idaho, succeeding Dr. **A. W. Fahrenwald,** who held the post for a year. Dr. Fahrenwald resigned so that he would be able to pursue research and engineering work. He will continue as professor of metallurgy and ore-dressing, and Dr. Finch will conduct investigations in chemistry.

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To Attend Manitoba Meeting

Among reservations received to date for the annual western convention of the Canadian Institute of Mining and Metallurgy, to be held this year in northern Manitoba, are those made by L. L. Boulton, Assistant Deputy Minister of Mines for Canada; Dr. R. C. Wallace, Manitoba's first commissioner of mines and now president of the University of Alberta; Dr. J. S. De Lury, Provincial Geologist of Manitoba, and president of the Institute; John McLeish, Director, Mines Branch, Department of Mines for Canada; A. W. G. Wilson, Chief, Division of Mineral Resources, Mines Branch; Prof. T. L. Walker, University of Toronto; Prof. John A. Allan, University of Alberta; George E. Cole, Director of Mines for Manitoba, and chairman of the Manitoba Branch of the Institute; R. C. Rowe, Editor of the *Canadian Mining Journal,* Montreal.

OBITUARY

J. C. Yore, pioneer prospector in Utah, Colorado, and Nevada, died at the home of his sister, at Carlin, Nev. He was 70 years of age.

George Howard, pioneer miner of the Bisbee district of Arizona, died recently in the Calumet & Arizona hospital, at Bisbee, as the result of injuries sustained in a fall of sixteen feet when a railing on top of a boiler in the old C. & A. power plant gave way. He had been an employee of the company for twenty years.

Dr. **Gordon Richardson,** head of the research department of the Maywood Chemical Company, at Maywood, N. J., died on Aug. 5 at a hosiptal in Hackensack, N. J. He was 72 years of age, and had been a professor of chemistry at Oxford University, and at McGill University, in Montreal. For the last few years Dr. Richardson had been doing research work on beryllium. He is survived by his widow and one son.

NEWS OF THE INDUSTRY

New Matahambre Main Shaft Nearing Completion

By Sept. 1, or about sixteen months after shaft sinking started, the new four-compartment shaft at the Minas de Matahambre property, in the Province of Pinar del Rio, Cuba, will be bottomed at 2,200 ft., according to D. D. Homer, general manager of the company, who is now in New York. The average speed of sinking indicated is, therefore, 150 ft. a month. Within another seven months, or about May, 1931, the shaft will start hoisting copper ore. It will handle the entire mine output and is being equipped to hoist a maximum of 135 tons per hour, or about 1,600 tons per hoisting day.

Work on the new shaft was started in April, 1929, under the direction of the E. J. Longyear Company, of Minneapolis. It is steel-timbered throughout and is equipped with a 125-ft. steel headframe. After it has been bottomed, the work of cutting pockets and doing the necessary lateral work to connect the shaft with the orebody is expected to take about four months. Subsequently, the new 800-hp. double-drum electric hoist will be installed. It will be built by Nordberg Manufacturing, of Milwaukee, and will have electric equipment furnished by General Electric. Hoisting will be done in 5-ton skips at a maximum rope speed of 1,600 ft. per minute. After hoisting and preliminary breaking at the surface, the ore will be sent to the crushing plant at No. 1 shaft. The distance between the two shafts is 1,700 ft. The company has not yet decided whether to use a cable tramway or a belt conveyor to connect them. No. 1 shaft is now used for hoisting.

At the concentrator, a new ball mill and a Dorr classifier are being installed to increase capacity to 1,300 tons of ore daily. At present the plant is operating at capacity on a six-day week and handling about 32,000 tons of ore a month. Production last year was about 17,000 tons of copper and is now at a slightly lower rate. The company will not increase output until the condition of the copper market improves. Ore at Matahambre averages about 5 per cent copper and is concentrated to a 30-per cent product before shipping to the Carteret plant of American Metal, in New Jersey, for smelting. American Metal has complete ownership of Minas de Matahambre.

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Mexican Metal Output Low; Many Shutdowns Imminent

According to figures given out by the Mexican Treasury Department, taxes on metal production for July reached the lowest figure in years—822,151.39 pesos. In February they exceeded 1,000,000 pesos, but they have been steadily decreasing every month. It is feared that a number of operators will be obliged to close within the next 60 days unless there should be an unexpected rise in silver prices.

Reports of suspension of activities at Fresnillo, by the Mexican Corporation, are denied by the management. Actually, about 100 employees have been laid off, and a small discount in wages above 4 pesos has been put into effect to the satisfaction of all concerned. The company continues operation with more than 2,000 men on its payroll.

Mining is practically at a standstill in Oaxaca. The Natividad, a high-grade silver property with ore of high gold content, continues normal production, and Robert Wilson is erecting a small mill at the San Francisco mine, in the Tavichi district. These practically sum up activities in the state.

Dos Estrellas, State of Mexico, has asked for permission to reduce the number of its employees and to make a reduction of 25 per cent in salaries. Mazapil Copper, at Concepcion del Oro, Zacatecas, insists before the Board of Arbitration on the necessity of a complete suspension of activities.

■

Mexican Government Rescinds Labor-Cut Decree

The Mexican government has rescinded its recent decree permitting mining companies to discharge 50 per cent of their employees, according to reports in New York newspapers. An Associated Press dispatch states that in the silver-mining district near Pachuca, Hidalgo, serious disturbances, in some cases amounting to riots, have occurred. The largest operator in the district is Real del Monte, U. S. Smelting, Refining & Mining subsidiary. This group of mines, the largest silver producer in the world, has an annual production of 18,000,000 oz., mills 3,500 metric tons daily, and employs more than 5,000 men. Inquiry at the office of U. S. Smelting, Refining & Mining reveals the fact that officials of the company are conferring with officials of the Mexican government.

■

A. S. & R. Closes Smelter at Monterrey, Mexico

Operation of the lead smelter of American Smelting & Refining at Monterrey, Nuevo Leon, Mexico, has been suspended because of the low metal prices, which have caused shutdowns at many of the mines that supply the smelter. Permission for suspension was obtained from the government and the smelter closed early in August, after handling its accumulated ore and concentrate supply.

Mines that are continuing production and that normally ship ore to the Monterrey smelter have had to divert shipments either to the A. S. & R. plants at Chihuahua and San Luis Potosi or to the American Metal plant at Monterrey. The smelter which closed is the second largest lead smelter in Mexico and has a capacity of 350,000 tons of charge annually in six blast furnaces.

New Mexican Mining Law Effective Oct. 1

The newest Mexican mining code becomes law on Oct. 1. Several important additions and changes to the present law have been made, the principal features of which were among the suggestions offered by the permanent committee of the Mining Congress, composed of the leading mining engineers and operators in Mexico. Among these important changes is the creation of preliminary exploration concessions for two years, during which time concessionaires may work properties, sell the output, and pay no taxes or engineering (surveying) expenses beyond the erection of a single monument or boundary mark. These concessions are intended to stimulate the small miner or prospector, and are limited to claims 300x300 m. in size. The new law establishes only one concession for each exploitation, without area or time limit. A stipulated amount of work is required. For the first five years 50 per cent of the work exacted under the law is required, and a reduction of 50 per cent in taxation is allowed. After five years the full requirements of the law must be met annually.

Concession for operation will include the right to erect a metallurgical plant, or plants, as required, without additional concession as necessary under the present laws. There are numerous other changes of smaller import. The new law does not meet the full demands of the mining interests in general, but is considered a great improvement on present legislation.

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Peñoles Considering Mill for Concepcion del Oro Area

Cia. Minera de Peñoles, American Metal subsidiary in Mexico, is investigating the situation with respect to building a mill for lead-zinc sulphide ore near Concepcion del Oro, Zacatecas. The company has leased the property of the Nazareno y Catasillas company in the district, as well as the adjoining Refugio mine. In addition it holds the Avalos property. At present, Mazapil Copper is operating a concentrator on ore from its own mines in the district. H. D. Bemis, mill superintendent at the Pecos plant of American Metal, at Glorieta, N. M., is now in Concepcion del Oro in connection with the proposed plant.

■

Kennedy Cuts 4,800 Level

Kennedy Mining & Milling, operating a gold property near Jackson, Calif., is now drifting southerly upon its 4,800 level, which is 150 ft. below the 4,650 level of the vertical shaft. Below the latter level an incline was sunk to give access to the 4,800 horizon. A crosscut easterly from the incline intersected the vein at a distance of 225 ft. At this point the vein is 3 ft. in width. At a point 283 ft. south the vein is 10 ft. in thickness. Good ore grades have been encountered.

Park Utah Con. Develops New Ore in City Unit

Development in the City unit of Park Utah Consolidated, in the Park City district, Utah, has already proved between 100,000 and 150,000 tons of ore of good grade in the new orebody developed below the 1,600 level. This new orebody is expected to show substantial profit as soon as prices of lead and zinc improve. Shipments from all the company's properties have been curtailed because of the current depressed metal markets. Last year, the City unit produced 123,939 tons of ore.

Work in the Utah unit of the company has not given such favorable results, however. Continued search for the downward continuation of the Western orebody on the 1,950 level has been fruitless. The Eastern orebody has an average width of about 5 ft. on this level.

Shipments from all the units are averaging about 400 tons daily, compared with the normal rate of about 1,000 tons daily.

■

New El Paso Leases Dump

New El Paso Mines, on Beacon Hill, in the Cripple Creek district of Colorado, has leased its mine dump, which is reported to contain over 100,000 tons of low-grade gold ore. A recent shipment of 150 carloads to the Golden Cycle mill, without screening, assayed a little more than $4 per ton. Screening is expected to effect a slight concentration. Mechanical loading equipment with a capacity of 100 tons daily is being installed.

■

Geology of Bingham Prospect

Attention has been called to an error in the article on operations at the Bingham Prospect property, Bingham, Utah, in *E.&M.J.* of Aug. 9. In discussing the development work done at that property, the article as printed stated that, "The quartzite separating the Jordan and Commercial limestone was not found, giving the management of the company basis for the theory that faulting had removed it, as well as about 200 ft. of the quartzite." As originally written by Gail Martin, author of the article, this matter read, "About 200 ft. of the quartzite, separating the Jordan and Commercial limestones, was missing, so that this measure in the Bingham Prospect was but 150 ft. thick. Furthermore, no Lark limestone has been exposed in the Bingham Prospect, which gives the management basis for the theory that this ore-bearing horizon was also removed by faulting as was a large part of the quartzite."

■

Butte & Superior Preparing for Complete Shutdown

Completion of the exhaustive development program that Butte & Superior has been undertaking at its copper-zinc property in the Butte district of Montana for several years is expected within a few months. Because of the rather disappointing results of this exploration work and the present depressed condition of the metal market, all operating activities at the mine will then cease, according to D. C. Jackling, president of the company. Actual mining has been suspended since May 1, with the exception of salvaging operations in a few unfinished stopes. Such ore as was left in these stopes would have become permanently unavailable had the stopes been abandoned immediately.

Production from Butte & Superior has been declining steadily in sympathy with the fall in ore reserves at the property. In 1927, the zinc ore mined had a total zinc content of 38,893 tons compared with an annual rate of about 20,000 tons in the first quarter of 1930. For the second quarter, zinc production was only 2,600 tons. Copper production has been small since 1926. Only 12 tons was produced in the first half of 1930.

■

Norway Aids Copper Mine

A loan of 550,000 crowns has been made by the Norwegian government to the Röros Copper Works, operating a copper mine and smelter at Röros, Norway. This loan will enable the company, which works a vein deposit carrying ore that averages about 2 per cent copper, to resume its modernization program. Regular operation and production is expected to be started about July, 1931. When operating at capacity, the company expects to employ about 300 men.

Portal to the Mayflower Mines tunnel, which has been driven more than 1,800 ft. in the company's exploratory work at Park City, Utah

San Juan Shipments Show Large Gain Over 1929

Mines of San Juan County, Colo., shipped altogether 1,366 cars of concentrates and ore in the first six months of 1930, an increase of nearly 400 cars, compared with the corresponding months of 1929. Of this amount, Sunnyside Mining, subsidiary of U. S. Smelting, Refining & Mining, shipped 1,176 cars of concentrates, carrying gold, copper, silver, lead, and zinc. Although admittedly now operating without a profit, or even at a loss, the increased gold content of certain oreshoots in depth is understood to have partly offset lower prices of the other metals.

Shenandoah-Dives shipped 103 cars of concentrates carrying gold, copper, lead, and silver. Colorado Mexico shipped 50 cars of concentrates carrying gold, copper, lead, and silver. Altamont Exploration shipped 21 cars of concentrates; Vertex shipped 14 cars of concentrates; and the Little Nation lease shipped 2 cars of ore. At present the first three companies are the only ones now shipping in San Juan County. Production for July was 185 cars for Sunnyside; 16 for Shenandoah-Dives; and 8 for Colorado Mexico.

■

New Flotation Unit Ready at Champion Copper Mill

No. 3 head, in the 2,000-ton mill of Champion Copper, at Painesdale, Mich., is now equipped for flotation treatment, and No. 4 will be changed over in about a month. This will give Champion four heads with the new flow sheet. Losses have already been cut to 2 lb. per ton of ore treated, and when all contemplated installations are completed, a reduction of losses to almost 1 lb. is hoped for. Even at the present rate of saving, all mill costs have been met by the additional copper recovered.

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Institute Meeting Date Changed

The annual meeting of the Lake Superior Mining Institute will be held in Duluth, Minn., and the Mesabi iron range on Sept. 10-12, instead of Sept. 9-11, as previously announced. The change was made by the Institute council because of the primary election to be held in Michigan on Sept. 9. A special train will take the members from Duluth to the Mesabi range. The banquet and business meeting will be held at Hibbing on Sept. 10. The following day will be spent on the range. There is no set program for the third day.

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Gold Strike at Little Annie

A gold discovery is reported from the Little Annie mine, at Summitville, Colorado, made by subleasers. Ore shipped to the Golden Cycle mill assayed $780 per ton. The vein is near the surface, and 3½ ft. wide.

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To Prospect Limestone Beds

Raising has been started in the North Standard mine, in the East Tintic district of Utah, from the 1,400 level to prospect the limestone beds underlying a large shrinkage cave opened up on the 1,200 level.

Moser Testifies at First Senate Silver Hearing

Hearings in the Senate investigation to determine the effect of the slump in silver upon export trade with the Orient opened on Aug. 8, in Washington, with the testimony of Charles K. Moser, chief of the Far Eastern Division of the U. S. Bureau of Foreign and Domestic Commerce. They were then adjourned to Aug. 27 at San Francisco, where several witnesses, including University of California experts who have recently surveyed conditions in China, will testify. Senator Pittman, chairman of the subcommittee conducting the investigation, announced that hearings will be held at Los Angeles, Seattle, Salt Lake City, Reno, Denver, and Spokane, before the committee returns East for hearings at New York, Akron, and Washington.

More than 40 witnesses are scheduled to appear during the course of the hearings, the object of which, according to Senator Pittman, is to determine the cause for the $17,000,000 decrease in export trade with China this year, to examine the various factors that have contributed to this depression, and to decide, if possible, upon remedial measures.

Mr. Moser submitted a letter from Dr. Julius Klein, Assistant Secretary of Commerce, describing the principal factors depressing export trade with China as: (1) the renewal of extensive military activity in that country; (2) the lower prices obtained in world markets for many commodities; and (3) the low price of silver. Dr. Klein reported that imports from China have decreased $22,879,000 during the first five months of 1930, compared with the corresponding period of last year, and that exports to China have suffered a reduction of approximately $17,000,000 during this period. With reference to currency conditions affecting export trade to China, Dr. Klein explained that, as China is on a silver basis, she receives all her income in China in silver, while all she receives from abroad must be paid for in silver but upon a gold valuation.

Dr. Klein informed Senator Pittman that the decline in silver has no direct bearing upon our foreign trade with Latin-American countries. The effect that the exchange price of silver may have upon trade with such silver-using countries is a corollary subject of inquiry by the Senate committee. Dr. Klein explained that the Latin-American countries are on a gold standard basis, either actually or nominally, silver being used merely for subsidiary currency of a dollar or less. The silver peso is the common circulating medium in Mexico, although the gold peso is standard and the basis of exchange, but there is no apparent ascertainable relationship, said Dr. Klein, between the value of the silver peso in terms of gold pesos and fluctuations in bar-silver prices.

First-hand information on conditions in China was presented to the committee by Mr. Moser, who returned in June from an extensive tour of the Orient. Mr. Moser expressed the opinion that even if silver were at a normal price, China's imports would still be greatly reduced because of the difficulties of getting them distributed through the interior. Concerning China's export trade he said that as silver is the medium of exchange, one would naturally expect that a decline in its price would correspondingly increase the sale of Chinese products in world markets, especially if, as at the present time, low commodity prices also rule. But China's exports have decreased even more than its imports. The answer is, in Mr. Moser's opinion, that China's products cannot be moved or distributed from the area of production because of the disruption in transportation lines brought about by the existing civil war.

■

Senator Pittman Would Loan Silver Stocks to China

Senator Key Pittman, of Nevada, is pushing plans to export domestic stocks of silver in the form of a huge loan to China. As quoted in recent press statements, he believes that a loan of $500,000,000 in silver dollars, together with proper treaty arrangements, would help restore silver to its normal price. Some of the European powers would be invited to enter the arrangement. The fund would be used for internal improvement in China under the direction of the nations concerned.

Large silver reserves are lying idle in the United States Treasury, Senator Pittman points out. We cannot use them effectively. China can, since it is on a silver basis. The silver coin of China is mostly locked up in the treaty ports because of internal warfare and because its low price does not encourage foreign trade. Senator Pittman suggests that the circulation of silver through China mainly for the construction of much needed transport facilities would create both a financial and physical structure encouraging trade.

The loss of exports to China has been the entering wedge for a subcommittee of the Senate Foreign Relations Committee. Senator Pittman is chairman and the investigation is operating under Senate Resolution 256, which he introduced during the last session. Plans outlined above are, of course, largely tentative.

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Opening Mammoth Channel Property

Cory Mining, of Magalia, Butte County, Calif., has acquired gold property on the Mammoth and Magalia channels and is completing a two-compartment shaft. Charles Thurman was recently appointed a director of the company.

To Hold Manganese Convention in November This Year

The annual convention of the American Manganese Producers' Association, usually held in September, will be postponed this year until November because of the excessively hot weather. In previous years, the members of the association have vigorously protested against coming to Washington during the summer.

The demand for an embargo on imports of Russian manganese ore probably will be renewed at the November meeting, as there does not appear to be any prospect of such action by the Treasury Department in the meantime. The department is presumably investigating conditions surrounding the production and export of Russian manganese to this country, but it is hampered by the lack of independent sources of information which would indicate definitely whether the ore is mined by convict labor and/or is being dumped in the United States at prices lower than domestic prices.

■

Mount Lyell Water Shortage Restricts Operations

Because of the prolonged dry season and the consequent low level of water in Lake Margaret, smelting operations were discontinued a few days earlier than customary at Mount Lyell, according to an announcement by directors of the company, which operates a copper property in Tasmania, Australia. Other operations are being continued as usual. As a rule, the blast furnace at the plant is in operation about 180 days of the year. Unless the unprecedented shortage of rainfall continues, financial results will not be affected. Output for the first nine months of the current financial year has been 6,960 short tons, compared with 5,276 tons in the corresponding period of the previous year.

Rainfall at Lake Margaret, 3 miles from the smelter, is about 140 in. annually. Since the increase in capacity of the power station to provide power for the Rosebery unit of Electrolytic Zinc, more water has been used than formerly, and the water level in the lake has dropped 30 ft.

The Mackay School of Mines, in Nevada, as photographed last January

Trend of the Times

BUSINESS activity has increased, and *The Business Week* index moved upward for the first time since the beginning of July. It stands at 87.4 per cent of normal, as compared with 86.5 per cent a week ago, and 113.7 a year ago. . . . . The upturn occurred in spite of disposition of many business men to sit tight until effects of the drouth can be more accurately appraised. These, as early exaggerations fade, will be discovered not to be calamitous. . . . . There is reason to believe that the worst is over—that recovery has begun; that it will be rapid as compared with 1921. . . . . Check payments increased last week; so did freight shipments of commodities most representative of commercial activity. . . . . Productive activity decline is less steep. . . . . Chicago grain traders evidently agree with us that early drouth damage reports were exaggerated; grain prices sagged. . . . . Other raw material prices continue to weaken. . . . . Approach of fall weather will start the seasonal upswing, renewed buying will strengthen prices. . . . . Sentiment in financial quarters continues to lag behind sentiment in commercial circles. Banking caution, not to say timidity, is retarding business. . . . . Too much importance is still being attached to the figures on the ticker tape; stock prices rise and fall in a purely professional market.—From *The Business Week* of August 20.

Atlas Makes First Shipment of Concentrate from Development

Atlas Mining, near Mullan, in the Coeur d'Alene district of Idaho, made its first shipment of concentrate on Aug. 12, an event of considerable importance in that district, as it is material evidence of the progress of perhaps the most daring development enterprise that was ever undertaken in the Coeur d'Alenes. It consisted of driving a crosscut tunnel 7,000 ft. on the south side of the river, a section that has long been looked upon with disfavor and has therefore received comparatively little attention in the way of development. About four years ago W. Earl Greenough, mining engineer of the Coeur d'Alene district, after making a study of that section, effected a consolidation of several groups of claims and began to finance a comprehensive development program, the first step in which was to drive a crosscut tunnel to cut at great depth the Carbonate Hill, Idaho Giant, and other veins known or believed to be within the course of the crosscut. The Carbonate Hill vein was cut 3,000 ft. from the portal, followed by the Idaho Giant, and finally another vein which could not be definitely identified.

Completion of the 7,000-ft. crosscut was followed by drifting east on the Carbonate Hill vein. This had progressed about 3,000 ft. when a lead-silver oreshoot was struck showing 8 ft. of commercial ore. After exploring this for a short distance, Mr. Greenough adopted an unusual plan before proceeding with its further development. To avoid the waste and expense of rehandling ore, he arranged to have the Gold Hunted mill, on the opposite side of the canyon, treat the ore and proceeded to construct a cable tramway from the Atlas dump to the mill, a distance of 2,000 ft., with ore bins at each terminal. This plan has the additional advantage of giving the Atlas company the benefit of revenue saved on ore shipments. Drifting is now proceeding, and ore extracted in the course of development is allowed to accumulate until there is sufficient for a fair mill run. The carload shipment mentioned is the product of the first run. Discovery of this oreshoot is expected to be followed by other development enterprises.

■

Carson Hill to Resume Operations

A new organization, bearing the name Carson Hill, Ltd., has taken over the Carson Hill gold property near Melones, Calaveras County, Calif. All the holdings of the old Carson Hill companies are included, and plans are being made for the resumption of mining. The directors of the new company are: L. Monte Verde, F. A. Beauchamp, W. A. Sunderland, F. M. Helm, W. E. White, and N. H. Manuel. This group of mines has passed through many long periods of inactivity since 1850, when the Morgan, the first of the group to be opened up, was discovered. Most of the operations in the district have been on a small scale.

■

Mutual Mines Building Mill

Mutual Mines Development, operating on Canyon Creek about three miles from Wallace, in the Coeur d'Alene district of Idaho, is constructing a flotation mill of 100 tons' capacity, which is expected to be completed in about 90 days. This company has been engaged in a development campaign on a large group of claims for four or five years. Ore exposures, particularly in a drift from the bottom of the shaft sunk 150 ft. from the main tunnel level, indicate an extensive body of lead-silver ore, and its development has proceeded sufficiently to justify construction of the mill, which is planned with the view to increasing the capacity if found desirable. The portal of the operating tunnel and the mill are within a few hundred feet of two railroads and a paved highway. The mill was designed by R. S. Handy, metallurgical engineer, superintendent of mills for the Bunker Hill & Sullivan company.

Jack Waite Reorganized; Under New Management

Meeting at Wallace, Idaho, on Aug. 18, stockholders of Jack Waite Consolidated Mining, owning a lead-silver-zinc property near Wallace, in the Coeur d'Alene district, voted to reorganize the company. The new company will be incorporated in Arizona, and have a capitalization of $3,500,000, in shares of $1 par value. The present 5,000,000 shares of capital stock will be exchanged at a ratio of 5 shares of old for 1 share of new. The remaining $2,500,000, according to statements by the new board of directors, will be used for financing improvements and an expansion program. Eighty per cent of the stock was represented at the meeting. The new controlling interest, headed by J. F. Duthie, of Seattle, Wash., voted more than 3,000,000 shares. The old directorate and management have resigned. John R. Turner, mining engineer, was appointed manager of the property. R. S. Terhune and G. W. Klinefelter, both of Seattle, were elected president and secretary, respectively.

Jack Waite ceased operations on about July 1. The immediate cause of the shutdown was a number of complaints of water pollution, as the company had no other way of disposing of tailing than dumping it into Tributary Creek, and thence into Eagle Creek and the North Fork of the Coeur d'Alene River. Contributory causes to Jack Waite's lack of success were the high cost of transportation: inadequate land on which to build a suitable mill and mine buildings; and lack of water rights.

The board of directors has announced that $325 000 will be spent on immediate work toward carrying out the new plans. These include the construction of a new mill, which will have a capacity of 500 tons daily; the extension of the railroad 4½ miles up Tributary Creek to the mill site; and the purchase of adjoining ground for a mill site, timber tract, and space for impounding tailing.

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Dayrock Purchases Option Claims

At a special meeting of the stockholders of Option Mining, held at Wallace, Idaho, on Aug. 12, the offer by Dayrock Mining of 36,000 Dayrock shares for two claims owned by Option was accepted. Dayrock had made an alternative offer of $72,000 in cash. Dayrock owns 69 per cent of the Option stock, and by resolution of Dayrock directors these shares were voted in accordance with the wishes of a majority of the minority of Option stockholders. The two claims adjoin the Dayrock property, and cover a parallel vein which has been developed by a crosscut at a depth of 200 ft. as well as by a tunnel from the surface.

■

Viborita Gold in Operation

Operation of the new hydraulic plant of Viborita Gold Mines, operating an alluvial gold property near Amafi, Antioquia, Colombia, has been started. The plant has a rated capacity of 6,700 cu.yd. of gravel daily. Reserves have been estimated at 45,000,000 cu.yd., of which 30,000,000 cu.yd. has an average grade of 6.25d. per cubic yard. Construction of additional ditches to insure the necessary water supply for capacity operation is expected to be completed in September.

Canadian Institute Convention to Meet in Manitoba

Meeting in northern Manitoba, the Canadian Institute of Mining and Metallurgy will hold its annual western convention during the first week in September. The program of entertainment has been mapped out for the visitors by a committee of the "North of 53" branch of the Institute. The first day, Sept. 2, will be spent at Flin Flon, where they will be guests of Hudson Bay Mining & Smelting and will be shown all over the plant. The next day the party will be at Sherridon, where they will be shown the Sherritt Gordon property by members of the staff. The third day will be spent at The Pas. There will be two sessions here, occupied by the hearing of papers prepared by northern Manitoba mining men on various phases of their work. Among these are a paper on the history of development and organization at the Flin Flon mine, and a paper by the staff of Sherritt Gordon on mining and milling methods to be used in developing this property.

The headquarters of the party on their tour through the northern Manitoba mining centers will be a special train scheduled to leave Winnipeg Sept. 7. Reservations are being sent to Osborne Scott, general passenger agent, Canadian National Railways, Winnipeg. On the concluding day of the convention, Sept. 4, the attending members will be guests of the Pas Board of Trade at a banquet given in their honor. A feature of the lighter side of the convention will be golf on the Sherridon course, claimed to be Canada's northernmost and most hazardous course. Entertainment on the train journey is being arranged for by the Winnipeg branch of the Institute.

■

Broken Hill Mines Close After Wage Dispute

An offer made by three mining companies at Broken Hill, New South Wales, Australia, to the labor unions, that workers accept a 17½ per cent wage cut for three months, so as to maintain operations in the face of the present low lead, zinc, and silver prices, has been unanimously refused by the unions. Officials of the unions characterized the proposal as ridiculous, claiming that even this cut would not permit the mines that have shut down to operate at a profit. The Block 14 company suspended operations on July 5, and Broken Hill Proprietary on July 6. North Broken Hill closed its British mine, but is employing some of the men at the North mine, married men being considered first i nthe transfer. More than 2,000 men are estimated to be unemployed at present in Broken Hill, which has a total population of 27,000. The New South Wales government is assisting 100 single men and 164 families to the extent of £1 weekly.

Many suggestions are being made to the Australian government concerning the mining situation. A bonus of 1s. an ounce on silver produced; extension of the zinc contract with the British government; and assistance to unemployed miners wishing to prospect, are among them, but the government is not expected to take action on any of the proposals.

Broken Hill Proprietary and Block 14 were both closed from September, 1927, until September, 1929, because of low metal prices. After they reopened in 1929, both shipped their ore to the Central mill of Sulphide Corporation.

Hoisting cables have been removed, evidently in preparation for a long cessation of operations. The British mine of North Broken Hill had been in continuous operation. The last ore reserve estimate for North Broken Hill was 4,000,000 tons on June 30, 1929. Of this tonnage, 800,000 was in the British mine, which has been producing only about 500 tons daily. The other two mines to close were also producing about 500 tons daily each.

Broken Hill South, the North mine of North Broken Hill, and Zinc Corporation, the three largest producers in the district, are continuing at their normal rates, although the second of these properties has stopped recovering the zinc content of its ore.

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Sherritt Gordon Not to Recover Zinc Content of Ore

Recovery of the zinc content of its copper-zinc ore will not be attempted when operations are started by Sherritt Gordon Mines, which is now constructing an 1,800-ton concentrator at Sherridon, northern Manitoba. Because of the depressed condition of the zinc market, the directors of the company have decided that only the copper content of the ore, which averages about 3 per cent copper and 3.5 per cent zinc, will be recovered. Production is expected to start in December, and for a while may be maintained at only two-thirds of rated capacity. The majority of the ore put through the plant will probably come from the West orebody, which averages close to 4 per cent copper and only about 2.5 per cent zinc. Sherritt Gordon's potential zinc output had been estimated at from 11,000 to 12,500 tons of metal annually.

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C. M. & S. Gets Power Rights

The British Columbia Provincial Water Board has granted West Kootenay Power & Light, Consolidated Mining & Smelting power subsidiary, all power rights on the Pend d'Oreille River in British Columbia. The company expects to develop 275,000 to 350,000 horse power on the river, but several years will elapse before the plant can be completed. In the meantime the company will push construction work on the new plant on the Kootenay River. two miles above its Upper Bonnington Falls station, and it expects to have this plant in operation by the winter of 1931-32. Unexpected engineering difficulties have developed at the company's Adams River dam, the completion of which will probably be delayed until late in 1932.

■

B. C. Blister to Copper Cliff

Blister from the Anyox smelter of Granby Consolidated, in British Columbia, will be shipped to Copper Cliff, Ont., for refining by the new Ontario Refining plant. Anyox blister formerly went to Tacoma, Wash., for refining. The Ontario Refining plant has a capacity of 120,000 tons of copper annually, most of which will come from the new Copper Cliff smelter of International Nickel, built to handle ore from the Frood mine.

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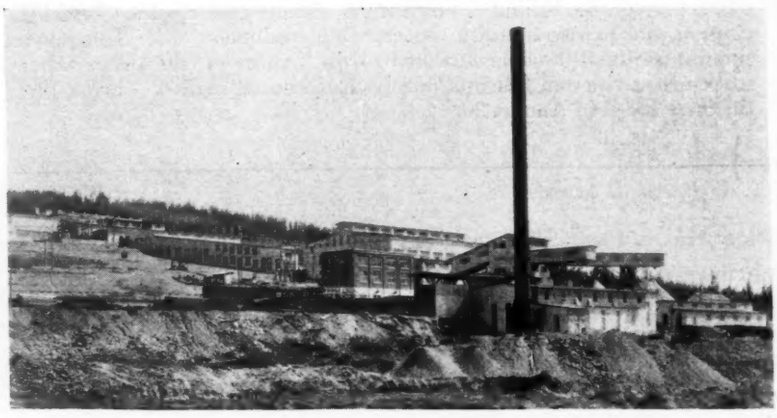

The enlarged Sullivan concentrator of Consolidated Mining & Smelting, at Kimberly, B. C. The plant is now handling 6,000 tons of lead-zinc ore daily.

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B. C. Forest Fires Reported

Prolonged hot, dry weather has made the fire hazard unusually bad throughout southern and central British Columbia, and large forest fires are reported from many points. Granby Consolidated lost a temporary camp and equipment on a group of claims it was developing on Adams Lake Plateau, north of Kamloops. The company also lost two houses occupied by workmen at its Cassidy colliery, near Nanaimo, Vancouver Island.

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Capital Dredging Starts Operating

Capital dredge No. 3, an 18-cu.ft., steel-hull gold dredge, was recently placed in operation by Capital Dredging, near Sacramento, Calif. The dredge was originally Yuba No. 16 of the Yuba Consolidated Goldfields at Hammonton, Calif. It was dismantled and re-erected by the Yuba Manufacturing Company.

Sunshine Mining Operating at Capacity Despite Serious Depression in Silver Market

ALTHOUGH silver mines throughout the West have generally suspended production on account of the extremely low price of the metal, the Sunshine mine, near Kellogg, in the Coeur d'Alene district of Idaho, is maintaining its recently increased output. The mill operated 27 days during July, handling 13,000 tons of ore, or an average of 481 tons daily, on a three-shift basis. The mine was worked on a two-shift basis. Last year the Sunshine mill treated an average of about 200 tons daily. Recently, the mill capacity was increased from 275 tons to 500 tons daily. Estimates based on the known high silver content of previous shipments place the value of the concentrate at about $10,000 per 50-ton carload.

The metal content of Sunshine ore, according to the company's 1929 annual report, is 27¾ oz. silver per ton, 1.33 per cent lead, and 0.0024 per cent copper, from which it is evident that silver is the sole reliance for profit. In this report, C. C. Samuels, manager, stated that the actual cost of producing silver was 20.45c. an ounce, and he added that the cost would be further reduced in 1930 as a result of projected capacity increase and increased efficiency assured by the operation of the new hoist. No figures are yet available since the completion of these new improvements, but the net profit for the month of July indicates that the management is making good its prediction that costs would be further reduced. Operating profit for the month was $39,576.84, from which $5,000 income tax was deducted, leaving a net profit for July of $34,576.84. The average price of silver for the month was 34.346c. per ounce.

On Aug. 4, the double-drum hoist recently installed was put into operation with both drums. Before Aug. 4, only one drum had been in use. A separate auxiliary hoist will be installed on the 1,300 level for shaft sinking, which will be started soon without interfering with regular productive operations. This exploration below the 1,300 level is being watched with considerable interest, as it will provide much information as to the future of the mine and the whole district.

Sunshine Mining employs 190 men. This number is considerably greater than has been required since the installation of improved equipment and introduction of other economies. The management, not wishing to lay off men at this time, because of the dearth of employment, has adopted the plan of having the employees work three weeks and lay off one week, thus providing work for all, and at the same time reducing the force 25 per cent.

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Ducktown Sells Fontana Mine to New York Interests

Sale of the Fontana copper mine, largest producer in North Carolina, to H. M. Thompson, of New York, has been announced by Ducktown Chemical & Iron. Litigation over property rights was said to be one of the reasons for the sale. Ducktown has operated the property for the last three years or so, but the title has been in dispute. The consideration is said to have been $262,000 for the 2,800 acres of ground included in the property, which is in Swain County. An option on 840 acres of mineralized ground adjoining the Fontana has also been taken by Mr. Thompson, who is said to represent important New York interests.

In 1928, the Fontana mine was virtually the only copper producer in North Carolina. In 1929, the Cullowhee mine, operated by Tennessee Copper & Chemical, produced some copper late in the year. Fontana has been shipping its ore to the Ducktown smelter at the rate of about 250 tons daily. Part of the ore has been concentrated previous to smelting. Production both in 1928 and in 1929 was about 4,000 tons of copper, as the average grade is about 4 per cent.

■

Drilling Contest to Feature Labor Day at Bisbee, Ariz.

One of the leading attractions of the Labor Day celebrations at Bisbee, Ariz., will be a rock-drilling contest for which prizes aggregating $100 have been offered. An entrance fee of $2 will be charged. A large rock will be placed on a truck in front of the grandstand in the Warren ball park. The task for the contestants will be to drill a hole one foot deep in the shortest possible time. Rules for the contest have been drawn up by the Labor Day committee as follows: All equipment will be furnished by the committee. Standard guard rails must be placed around the platform on which the contestants will work. Contestants must make non-leaking connections with air and water lines. They must turn air and water on and wear safety goggles. Failure to place safety bars or to wear goggles while drilling will cause a penalty of 10 sec. For failure to use gaskets the penalty will be 5 sec. for each gasket. Leaking connections will be penalized at 5 sec. each. Failure to use water will cause a penalty of 10 sec.

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Directors Watch First Cleanup at New Seven Troughs Mill

Directors of the company were present at the first cleanup of the new Seven Troughs gold mill at Lovelock, Nev., on Aug. 7, according to J. P. Graves, president. They witnessed the pouring of bullion into bars for shipment to the U. S. Mint at San Francisco. This cleanup represents the result of a twelve days' run. The directors present, who included two Canadians, E. W. Villeneuve and Paul Galibert, of Montreal, expressed themselves as pleased with conditions at the properties. They inspected the main tunnel through which both development and extraction of the ore are being done. It is now in about 9,000 ft. from the portal and is being extended to cut additional veins, which, the management expects, will carry ore. Ore is now being obtained chiefly from the 5,100 vein. The directors also examined the new 200-ton crushing plant and cyanide mill.

Will Resume Rate Hearings at St. Louis in November

Hearings in the Interstate Commerce Commission's investigation of the freight-rate structure on non-ferrous metals will resume about the middle of November in St. Louis for the purpose of covering the Tri-State field. Following the hearing on July 29-30 in Denver, the date for the St. Louis heading had been tentatively assigned for Oct. 16, but Examiner Mullen states that conflicting engagements have necessitated postponement.

After the hearings in St. Louis an adjournment will be taken to New York in December, when the rate aspect of the investigation will be developed. The hearings in the West were directed primarily to obtaining first-hand information on conditions in the mining industry. All metals were covered extensively with the exception of zinc, on which further testimony will be received in New York. Much attention will be given to transit practices at the New York hearing.

Shippers estimate that it will take four weeks for them to present their testimony on rates in the proceeding under the Hoch-Smith resolution. The railroads have practically completed their rate testimony, but they may desire to present some rebuttal evidence, in which case another hearing will be held in Washington, so it is not likely that hearings will be finally concluded until some time in January.

Examiner Mullen states that his proposed report will be prepared as promptly as possible, but he points out also that neither the interest of the railroads nor the mining industry would be served by rushing the investigations to a conclusion.

Since this inquiry was initiated, conditions in the mining industry have suffered a practically complete reversal that obviously will demand consideration by the Commission. If the case had been brought to an earlier conclusion any order that the Commission might have issued would have been out of tune with conditions that have subsequently developed.

■

Developing Old Plomo Mine

The old Plomo gold mine, near San Luis, Colo., has been known of definitely for half a century, but only recently have systematic attempts been made to arrive at a true estimate of its worth. Minasol Mining & Finance, of Denver, is sinking shafts and testing the ore in order to work out the best method of concentration.

The geological formation of this mine consists of a highly silicified volcanic rock, fairly uniformly metallized with iron pyrite and gold. Estimates so far made show at least 5,000,000 tons of commercial ore to be available.

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General Manganese Building Mill

General Manganese Corporation, of Detroit, is building a 50-ton mill near Mitchell, S. D. The flow sheet embodies a method of treating low-grade manganese ore by leaching, and the mill is planned to produce 15 tons of concentrate per day.

Semi-Annual Tax Returns Reveal Status of Nevada Mining Operations

THE returns of the Tonopah mines to the Nevada State Tax Commission for the first half of 1930 reveal a marked decrease in both gross and net revenue, owing to the unusual depression in the silver market that prevailed during the period. Tonopah Extension reports 46,036 tons mined and milled, of average value of $8.54 per ton. The gross yield was $393,153.05, deductions being $396,793.19. A loss of $3,640.14 was therefore incurred for the six months. Tonopah Mining reports 4,984 tons mined and milled, of average value of $15.2427 per ton, yielding $77,854.65 gross; deductions, $66,959.59; net, $10,-895.06. Mining operations were suspended in February. Returns from the milling company and railroad controlled by Tonopah Mining have not yet been filed.

Tonopah Belmont Development, operated by lessees, reports $14,463.38 from royalties. The company's share of operating expenses, as per agreement with lessees, amounted to $13,469.04; the net revenue accruing to the company was $994.34.

An important decrease in gross and net revenue is reported by Nevada Consolidated, whereas Consolidated Coppermines experienced an increase in both gross and net revenue as a result of mining an increased tonnage of higher-grade ore. Nevada Consolidated reports mining 1,583,495 tons of an average grade of $2.67 per ton, yielding $4,235,-711.37 gross and $1,019,647.05 net, after deducting $232,728.98 depreciation on machinery and equipment, and $2,983,-335.34 operating costs, as compared with a return for the last half of 1929 of $8,469,285.72 gross and $3,984,119.61 net. Value per ton for this period of 1929 was more than $3.46. Consolidated Coppermines reports 601,869 tons mined and milled during first half of 1930, the value being $5.1175 per ton. Gross revenue was $3,080,067.04 and net revenue $2,400,957.47 as compared with a gross revenue of $2,531,440.92 and a net revenue of $111,670.57 for the last half of 1929.

Bradshaw, Inc., treating the tailing of Goldfield Consolidated, reports milling 118,000 tons. The average value recovered was $1.107 per ton; gross revenue, $130,631.51; deductions were $84,212.64; and net revenue was $46,418.51. The company paid $1,546.30 county tax and $9,515.36 royalties to the Goldfield Consolidated. This royalty payment, together with other income, brought the total receipts of Goldfield Consolidated up to $10,050.74. The company has not yet received any income from its holdings in Base Metals, but expects to do so before the close of this year.

Although its furnace was idle for nine weeks, Castle Peak Quicksilver reports 3,126 tons of ore treated that yielded an average of $14.98 per ton. Gross revenue was $46,833.50; deductions, $27,-258.92; and net revenue was $19,574.58.

According to the company's report to the Tax Commission, operations of Treadwell Yukon, at Tybo, have been at a loss of $64,595.05. Gross revenue was $540,586.82; operating costs were $605,181.87, including $118,221.16 mining cost; refining, reduction, and sale costs, $262,074.56; transportation was $103,337; depreciation, $23,834.02; and royalties to Morey Mining were $6,982.58. The sum of $86,407.68 was expended in development work.

White Caps, at Manhattan, reports 2,087 tons mined, of an average value of $17.95 per ton. Smelter returns totaled $37,460.94. A truck haul of 45 miles to Tonopah and freight to the International smelter in Utah accounted for the largest item of expense, namely $22,456.89.

Three companies mining non-metallics have reported to date. Blue Diamond, operating in Clark County, produced 34,-872 tons of clay valued at $71,740.28. Net revenue was $15,231.47. Coen Companies, Inc., reports 4,178 tons of clay products shipped from the Bell mine, in the southern part of Nye County. The gross revenue was $59,483.50; deductions, including $4,215 in royalties, $54,142.10; and net revenue, $5,341.40. Coen Companies also mined 5,274 tons for Union Oil, gross revenue from which operations was $85,735 and net revenue $6,911.56.

The Portland Cement Company, operating at Gerlach, Washoe County, reported 32,989.69 tons mined. Deductions were $45,338.22 and net revenue was $37,-115.01. The company also filed a claim of $35,398.97 additional deduction for selling costs outside of Nevada; this claim was not allowed by the commission.

■

Construction Started on New McIntyre-Porcupine Mill

Excavation work has started on the site of the proposed new 2,000-ton mill at the property of McIntyre-Porcupine Mines, near Porcupine, Ont. The new mill will be located directly west of No. 11 shaft on the north side of Pearl Lake. Orders have been placed for part of the material and machinery, the intention of the management being to rush construction work so as to get the entire job under cover before winter sets in. Officials of the company expect production to be switched finally from the present plant to the new mill and the change made from complete cyanidizing to partial cyanidizing and concentration by about the end of March, 1931. With the new mill operating, an increase of from 25 to 40 per cent in actual production of bullion is expected.

■

Cripple Creek Output Gains

The depression in prices of silver and the base metals has stimulated interest in production of gold, and Cripple Creek, in Colorado, is showing signs of greater activity. Total production for the first six months of 1930 is given as 148,246 tons, with a gross value of $1,564,514. Total production in 1929 was $2,595,928.

Cresson Consolidated has given twelve separate leases on a block of ground above the tenth level. This company paid dividends of $24,440 on June 30. The Patti Rosa lease of United Gold Mines has developed an orebody reported as 50 ft. long and 6 ft. wide, with grade between $20 and $30 per ton. June shipments on this lease totaled 313 tons, with an average value of $26.50 per ton.

■

New Power Plant to Provide for Sudbury Requirements

The first definite step in the direction of providing supplementary power for the mines and metallurgical plants of the Sudbury district of Ontario was taken last week, when Ontario Power Service Corporation, owned and controlled by Abitibi Power & Paper, awarded a contract to Dominion Construction for construction of a dam and power house at Abitibi Canyon, 68 miles north of Cochrane on the Abitibi River. The development when completed will be capable of providing 275,000 hp., 85,000 hp. of which has been contracted for by the Ontario Hydro-Electric Commission for delivery to the Sudbury district at $22 per horsepower. Surveys are nearing completion in connection with the location of a high-voltage transmission line from the power development to Sudbury, a distance of 230 miles. The entire program, including cost of the power line and transformer stations, will involve an expenditure of approximately $23,000,000. Sudbury expects to receive power by the fall of 1931.

■

Gold Hill Ships First Bullion

Shipment of 53 lb. of bullion was the result of the first week's operation of the new 100-ton cyanide plant of Gold Hill Development, near Round Hill, Nev. This metal was valued at $4,600 in gold and $200 in silver, and is the result of what was actually a run of six days, as on Aug. 1 several adjustments were found necessary, causing a delay. H. A. Johnson, under whose direction the mill was built, says that the extraction is better than 94 per cent. The plant is now milling 100 tons daily, its rated capacity, but a slight increase is expected as operations continue. According to Mr. Johnson, over 1,100 ft. of the main orebody is exposed, with a width of 5 to 6 ft.

■

Noranda Ore Grade Improved

Noranda Mines, operating in the Rouyn district of Quebec, has increased its gold output by approximately $40,000 per month, or the equivalent of about 90c. per ton of ore mined, as a result of recent high-grade developments in the mine. The average gold recovery from Noranda ores is now more than $4 per ton. Despite reduced prices, Noranda copper production is being maintained on a basis of between 6,500,000 and 7,000,000 lb. monthly as compared with last year's average of about 4,300,000 lb. This is from an average smelter capacity of 2,000 tons daily, with the new concentrator treating about 650 tons daily.

■

American Metal Drops Option

American Metal has abandoned its lease and option on the Reina Victoria gold property, in the Holguin district, Province of Oriente, Cuba. The property was taken over in the spring.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

Bwana Report Favorable; N'Kana to Produce in 1932

London, Aug. 18.—Bwana M'Kubwa's report for the second quarter of 1930 shows its leaching recovery to be better than 84.22 per cent. Openings driven at N'Kana during this quarter totaled 3,632 ft., and drilling added up to 8,515 ft., making total drilling on this property to date 75,154 ft. The pilot mill treated 4,848 tons of ore, with an output of 180 tons of concentrate averaging 45.43 per cent copper. According to the report, satisfactory progress is being made in designing and constructing the plant. The Rhodesian Selection Trust second quarterly report states that Mufulira has drilled during this period 4,730 ft., and that openings totaling 1,145 ft. were driven. Men employed comprised 1,145 natives and 264 Europeans. Drilling and construction progress are described as remarkable.

. . . . Production at N'Kana mine of Bwana M'Kubwa Copper will start early in 1932, Sir Edmund Davis, chairman of the company, stated at a recent meeting of the stockholders. Issue of an additional 1,000,000 shares of the 5s. par was authorized at the meeting. In discussing the company's properties, Sir Edmund Davis stated that 80,000,000 tons of 3.9 per cent copper had been proved at N'Kana, which is now being equipped with a 10,000-ton concentrator. Of this tonnage, 59,000,000 averages 4.2 per cent copper. Cost of machinery and construction work last year was £371,918. The additional shares are being issued to finance the continuation of this work. Production from the Bwana mine in 1929 totaled 6,774 short tons of copper at a profit of £60,250. In July, 1930, the output was 616 tons. Changes have been made in the plant, and the company expects to be able to make a profit, despite the much lower price of copper now prevailing.

. . . . In discussing the properties in which Bwana has a considerable stock interest, notably those of the Rhodesian Selection Trust group, Sir Edmund stated that reserves at the Chambishi mine are now estimated at 25,000,000 tons averaging 3.8 per cent copper and at the Baluba mine about 25,000,000 tons averaging 3.2 per cent copper. Production plans have not been formulated for either of these properties. At the Mufulira mine, which is also to be equipped with a large concentrator, no estimate has recently been made. However, should hole No. 29 cut ore of width and grade similar to that encountered in other drill holes, the total reserves will be well over 100,000,000 tons of ore averaging more than 4 per cent copper, Sir Edmund indicated. No. 29 hole is being drilled about 1,500 ft. northeast of No. 15, which showed 120 ft. averaging 3.4 per cent copper, and about 2,600 ft. northeast of the outcrop. On the basis of the new estimates, total ore reserves of the Rhodesian copper properties would seem to be more than 400,000,000 tons of about 4 per cent copper ore.

. . . . What is described in the press here as the richest borehole yet drilled in Rhodesia is No. B36 on the N'Changa property. To date it has cut 100 ft. averaging 11.2 per cent copper, or, if the lower grade sections be excluded, 80 ft. averaging 13.3 per cent copper or 65 ft. averaging 15.3 per cent. It is reported cutting still deeper ore. This hole is on the western boundary of the property and is part of the continuation of the high-grade Rhodesian Congo Border into N'Changa territory. Hole No. NE13 of R.C.B.C. has been stopped after cutting no ore. This hole serves to delimit the high-grade orebody on the south.

. . . . Negotiations for the construction of the new 200,000-ton refinery at Liverpool, England, are still under way, with several groups participating in the discussion. This plant will handle Rhodesian blister copper.

. . . . At the annual meeting of Rhodesia Broken Hill Development, of which Sir Edmund Davis is also chairman, he stated that the ore supply above the 225, or water, level for the company's electrolytic zinc plant was sufficient for fourteen years. This includes only zinc silicate ores and does not take into account the high-grade lead-zinc sulphides indicated below the 225 level. The zinc plant turned out 1,570 long tons of zinc in July, compared with 1,632 long tons in June. Electrolytic zinc commands a good premium over standard on the MM London metal market. Costs of production for Rhodesia Broken Hill are among the lowest in the world, Sir Edmund stated.

■

Tin Restriction Still Progressing Slowly

London, Aug. 16.—Tin production restriction is making headway, although some companies still refuse to co-operate. Renong Tin Dredging, operating in the Rasa district, State of Selangor, Federated Malay States, has kept one of its three dredges shut down for two months, and a second will close at the end of this month for a similar period. Pattani Consolidated, operating in Siam, is undergoing financial reconstruction, but a statement has been issued by the company to the effect that every effort will be made to get into production as soon as possible. Siam tin exports increased in May.

. . . . The basis of the agreement reached by the recently formed world nitrate cartel in Berlin was a guarantee to be given to Chile that European producers restrict output to a certain amount, leaving a fixed share of the European markets to Chile. In return the European producers asked reciprocal privileges. This cartel includes both synthetic and natural nitrates; and every producing country except the United States is a party to the agreement. The entire Chilean nitrate industry will now be controlled by Cosach, the new corporation formed for the purpose.

. . . . Recent reports of dissension in the ranks of the African diamond producers are entirely unconfirmed. Usually well-informed people in London either disclaim knowledge of the rumors or state that they are uninformed from Africa. Others say that disagreement between the government of the Union of South Africa and the diamond producers is highly improbable, as, owing to the fact that £12,000,000 in stocks are being held, a break would disrupt the whole trade.

. . . . Arbitration between Lena Goldfields and the U.S.S.R., over a former Russian concession of that company, is once more in court. Officials of the company aver that the Soviet ignored certain rights and made unwarranted demands. There are also accusations of obstructions to operation. The Soviet has issued a brochure containing reprints of correspondence with the Lena management, but is not represented in court.

. . . . Reports from Oslo mention a new gold discovery in the Finmark district of Norway. Alluvial gold has been washed in this district, which is the northernmost part of Norway, every summer for a number of years, but these new claims will mark the beginning of lode gold mining. Owing to the motor industry depression in the United States, Norway proposes to reduce aluminum production.

. . . . There has been talk of a revival of interest in gold mining in West Africa. Dr. Malcolm MacLaren plans a trip there in the interests of Consolidated Goldfields and Anglo-Oriental.

■

Robinson-Village Merger Affects Output of Former Temporarily

Johannesburg, Aug. 16.—Showing a temporary rise in working costs, and a slight decrease in tonnage produced, the report of Robinson Deep explains these as the results of changes necessitated by the absorption of Village Deep, the adjoining property on the Central Rand. All arrangements connected with the change-over in operating methods have been completed, and the management states that it confidently anticipates improved profits in the immediate future. The previous combined output of the two mines was 450,000 oz. of gold annually. Robinson Deep is expected to increase this figure materially, according to present plans.

. . . . Considerable attention is being given by Rand mining men to reports of the discovery of a new gold field near Nondweni, in northern Natal. Options over a large area have been secured. Nondweni is a little more than 100 miles north of the nearest seaport, Durban, and about 70 miles in a straight line from the coast.

. . . . Consolidated Main Reef Mines & Estate, operating about 6 miles west of Johannesburg, Transvaal, has tendered application for additional claims on the Farm Vogelstruisfontein, which adjoins the company's western boundary. The company's present holdings in Farm Vogelstruisfontein amount to approximately 660 acres.

MARKET AND FINANCIAL NEWS

Possibilities of Zinc Cartel Interest London Trade

INTERNATIONAL METAL SERVICE, LTD.

London, Aug. 1.—Despite the mid-month flutter of excitement on the news that a basis of agreement had been reached, and that the long-talked-of International Cartel at length looked to have every prospect of coming into being, the closing London zinc quotations for July do not show any marked net changes over the month; July shipment closed at £16 in comparison with June at £16 3s. 9d.; and October at £16 11s. 3d., compared with September at £16 10s.

Actually, however, the month has witnessed several changes in sentiment and prices: At the beginning the price continued to sag until £15 12s. 6d. was reached, a low level for a good many years. Then, rumors that all was going well with the negotiations for a reformation of the cartel were noised abroad and there followed a rapid rise in the quotation to £16 16s. 3d. Then of course the inevitable happened: Speculators tried to cash in their gains; the consumptive demand petered out; and the higher level provoked rather freer offering, so by the end of the month we were back at £16 again.

As regards the cartel: Producers are encouraged at the favorable outcome of the Ostend Conference, whereat a basis for the establishment of a zinc cartel was discovered. Although full information has not been published, it is known that the underlying principle is the quota system. Much of the working detail has still to be settled, in which immense difficulty is foreseen. It is said that 87 per cent of the producers outside of the United States were represented at the conference, and the sponsors of the scheme fully appreciate that success is only possible if the interests responsible for the remaining 13 per cent are brought into line.

Assent to the project has still to be secured from the various producing parties, and it is by no means certain that all will ratify it. Already, we hear from Berlin that though it is hoped that the final agreement will follow, there is a certain amount of doubt because of the many obstacles to be surmounted and the long time it will take to overcome them. It may be close to the end of the year before the scheme can be put into operation.

One thorny problem in this respect may be to meet the cases of Australia and Canada, where the output of electroyltic zinc will expand. Domestic consumption of zinc is small in both countries, and there is comparatively little demand in the Far East: hence the only market for this Australian and Canadian High-grade metal is in Europe. The smelters in both countries naturally want to be able to dispose of their greater potential output.

Supposing that the next British government returned to power were to adopt the Empire Free Trade policy, with its accompanying tariff on foreign imports. What a revolutionary change there would be in some metals, including zinc! The latter would unquestionably be placed on the tariff list if produced outside the Empire: hence the full needs of the United Kingdom would be supplied by Australia and Canada and Great Britain herself. This possibility has, willy nilly, to be taken into account by the British Empire producers in assenting to any quota system other than for a comparatively short period.

According to our information, world production of zinc for the first six months of this year, expressed in short tons, is as follows:

January	141,100
February	126,900
March	140,300
April	132,200
May	133,900
June	128,100
Total	802,500

This is very little below the half-yearly average of 1929 of 810,600 tons; and the monthly average in 1930 of 133,750 tons compares with 135,100 tons in 1929. We had looked for a greater diminution in June; anyhow, July should be lower owing to the curtailment of smelting in Belgium.

The world production for the second half of the year will of course not amount to anything like that of the first six months if the recommendations of the Ostend Conference are adopted and become effective, but curtailment of output will need to continue for quite a little time before existing heavy stocks are reduced to normal, having regard to the depressed state of affairs in the consuming trades. Granting that August production may run a little higher, the output ought to balance the demand in September, and during the last three months of the year stocks may be expected to decline, provided the restriction of output recommended is put into practice.

Subnormal consumption throughout the world is what the industry is mainly up against just now. The galvanizing trade, which is the chief outlet, is especially depressed and appears likely to remain so for a long time. Financial and exchange problems in Australia and South America are adversely restricting orders for galvanized sheets, and business with India is in a parlous state and unlikely to improve until the political unrest is quieted.

Our estimate of world stocks of zinc on Aug. 1 follows, in metric tons:

United States	106,500
Canada, including afloat	8,200
German-Poland	19,100
Belgium	12,800
France	2,900
Great Britain	12,400
Other Europe	3,500
Australia, including afloat	14,000
Far East	2,500
Elsewhere	2,000
Total	183,900

This represents a gain of 15,800 metric tons in July.

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Nevada Con. Profits Show 90 Per Cent Decline

Net profit of Nevada Consolidated, operating properties in Arizona, New Mexico, and Nevada, was only $161,870 in the second quarter of 1930, after deduction of ordinary taxes and depreciation but before depletion. This is less than 10 per cent of the profit of $2,224,425 recorded in the preceding quarter. In the second quarter of 1929, profit was $3,786,253. For the first six months of this year, total profit was $2,386,295, compared with the record of $10,510,772 in the first six months of 1929. Copper production for the second quarter was 35,740,442 lb. from 2,032,934 tons of company ore. Net cost of producing copper was 10.28c. a pound. In the first quarter it was 9.76c. a pound.

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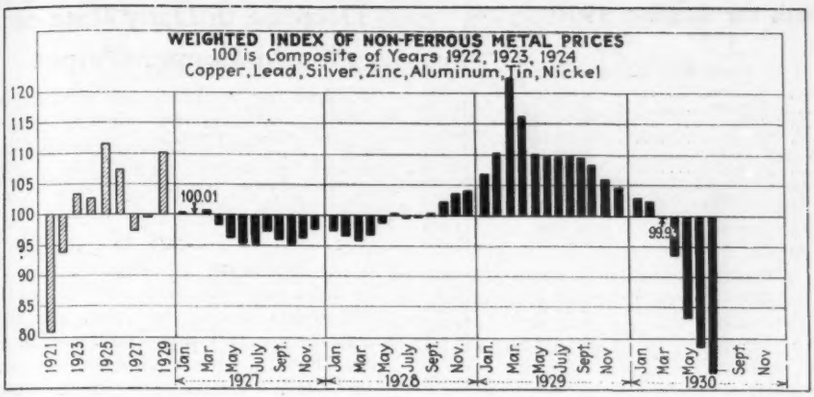
AHUMADA LEAD, operating a silver-lead property in Chihuahua, Mexico, reports net loss for the first six months of 1930 amounting to $71,444 after taxes and depreciation, comparing with a net loss of $20,516 in the corresponding period of 1929. Production was 5,478,809 lb. of refined lead, compared with 5,624,470 lb.

NEW JERSEY ZINC, operating properties in New Jersey, Virginia, and Colorado, reports a net income of $3,089,156 for the first six months of 1930, after deduction of all charges. Corresponding profit in 1929 was $4,474,741. Profit in the second quarter of 1930 was $1,417,288 and for the second quarter of 1929, $2,447,806.



Total Stocks of Copper Drop Despite Gain in Refined

Despite an increase in stocks of refined copper from 316,762 tons at the end of June to 322,039 tons at the end of July, the drop in stocks of blister metal was more than sufficient to wipe out this gain and total stocks of copper in the hands of American producers declined from 570,596 tons to 564,251 tons. Shipments in July were 117,902 tons, which were excelled only in May of this year. Shipments in June were 116,705 tons. As a rule, July shipments are lower than in June.

United States mine production showed the substantial drop of 141 tons in the average daily rate of production. Total output was 54,249 tons, the lowest monthly output of the year, and the average daily production was 1,750 tons.

Total stocks of copper at the beginning of the month, North and South America, in tons, follow:

North America	June 1	July 1	Aug. 1
Blister (a)	254,460	243,348	231,872
South America			
In blister at smelters	3,660	3,347	3,300
In transit to U. S.	6,986	7,139	7,040
Total blister	265,106	253,834	242,212
Refined	308,646	316,762	322,039
Grand total	573,752	570,596	564,251

(a) Includes stocks at smelters, quantity in transit, stocks at refineries, and quantity in process at refineries.

Distribution of U. S. copper production in June and July:

	June	July
Porphyry mines	20,295	20,633
Lake mines	7,235	6,354
Vein mines	23,935	22,562
Custom ores	5,278	4,700
Total crude production	56,743	54,249
Daily rate	1,891	1,750
Imports in ore and matte	8,113	.....
Blister from scrap	2,793	.....
Smelter production	69,155	.....

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WALKER MINING, operating a copper property in California, has passed its quarterly dividend of 7.5c., payable for the third quarter of 1930.

GEORGIA MANGANESE & IRON, in which Brunswick Terminal & Railway Securities holds $1,500,000 of first mortgage bonds, has been placed in receivership, incidental to reorganization. Brunswick Terminal also has a 40 per cent interest in American Minerals Corporation, a holding company that has all the capital stock of Georgia Manganese & Iron.

CALUMET & ARIZONA, operating copper properties in Arizona, reports profit of $844,781 in the second quarter of 1930, compared with $1,037,377 in the first quarter, and $805,325 in the corresponding quarter of 1929. Total profits for the first six months were $1,882,158 in 1930 and $4,495,942 in 1929. Production is still only 50 per cent of capacity.

BUNKER HILL & SULLIVAN, operating silver-lead properties in Idaho, reports profit of $181,696 in June, before depreciation or depletion. Profit for the second quarter of 1930 was $689,730, compared with $672,787 for the first quarter.

PODEROSA MINING, operating a copper property in Chile, reports net profit of £34,004 in 1929, compared with £54,838 in 1928. Production was 14,638 metric tons of ore, averaging 18 per cent copper.

PARK UTAH CONSOLIDATED, operating a lead-zinc-silver property in Utah, reports net loss of $49,256 after taxes and depreciation, but before depletion, in the first six months of 1930. Operating profit was only $7,776. Because of low metal prices, the company is producing only sufficient ore to meet expenses, the value of output for the half year being only $830,810.

TECK HUGHES GOLD, operating in Ontario, reports gross income of $4,167,168 in the nine months ended April 30, 1930. Profits, after taxes and depreciation, are estimated at $2,293,457.

IPOH TIN DREDGING, operating a property in Malaya, reports a net profit of £19,065 in the year ended March 31, 1930, compared with £30,269 in the previous fiscal year. Output was 466 tons of tin concentrate, compared with 533 tons in the previous year.

CHANGKAT TIN DREDGING, operating a tin property in Malaya, reports a net profit of £66,738 in 1929, compared with £30,901 in 1928. Production was 848 tons of concentrate, compared with 562 tons in 1928.

Zinc Corporation Earnings

Net profit of the Zinc Corporation, operating on a lead-zinc property at Broken Hill, New South Wales, Australia, was £246,050 in 1929, compared with £255,534 in 1928. The dividend rate was cut from 20 to 17.5 per cent on the common stock. Par value is 10s. Production in 1929 was 287,359 tons of ore, compared with 275,066 tons in 1928.

■

Boleo Profits in 1929

Compagnie du Boleo, operating a copper property in Lower California, Mexico, reports net profits of 24,904,285 francs in 1929, compared with 17,372,701 francs in 1928. The company had total assets of 326,419,116 francs on Dec. 31, 1929, of which 36,262,956 francs was in cash. Dividends paid totaled 20 francs per share, compared with 14.5 francs in 1928. Copper production was 11,705 metric tons, compared with 11,600 metric tons.

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Commerce With India in Silver

According to the monthly summary of foreign commerce of the United States, issued by the Department of Commerce, exports of silver from the United States to India for the first five months of 1930 amounted to 4,445,221 oz., as compared with 3,942,237 oz. in the same period of 1929. No imports of silver into the United States were reported in either period.

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Silver Output Down in June

Slight gains by the United States and Australia in June were the only exceptions to the general downward trend of silver production, as reflected by the figures released by the A.B.M.S. Final figures are now available for April and show a total output of 16,570,000 oz., compared with 18,343,000 oz. in March and 21,849,000 oz. in February. Mexico's silver output in April was 7,514,000 oz., compared with a peak of 12,717,000 oz. in February and 8,844,000 oz. in March. Available figures for June, with May figures in parentheses, follow: United States, 4,299,000 (4,293,000); Canada, 1,585,000 (1,585,000); Peru, 1,527,000 (1,959,000); and Australia, 730,000 (712,000).

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PATIÑO MINES & ENTERPRISES, operating the world's largest tin mines, in Bolivia, reports net income of $652,500 in the first six months of 1930. After payment of preferred dividends, the company shows a deficit of $338,000. Profits, after payment of preferred dividends in the first six months of 1929, were $2,799,000.

Mining Company Dividends for August, 1930

Companies in the United States	Situation	Per Share	Total Disbursements
American Smelting & Refining	Various	$1.00 Q	$1,829,940
Anaconda Copper, c, z, l, s	Various	0.87½ Q	7,724,550
Bunker Hill & Sullivan, l, s	Idaho	0.50 MX	163,500
Freeport Texas Sulphur	Texas	1.00 Q	729,783
Homestake Mining, g	S. Dakota	0.50 M	125,580
Miami Copper	Arizona	0.37½ Q	280,175
Mohawk Mining, l, s	Michigan	0.75 Q	86,250
National Lead "B"	Various	1.50 Q	154,913
New Jersey Zinc	Various	0.50 Q	981,632
United Verde Extension, c	Arizona	0.50 Q	525,000
Vanadium Corp. of Am	Various	0.75 Q	283,775
Companies in Other Countries			
Andes Copper	Chile	0.37½ Q	1,160,000
Cerro de Pasco, c, s	Peru	1.50 Q	1,684,263
Granby Consolidated, c	Canada	0.75 Q	337,500
Hollinger Consolidated Gold	Canada	0.05 M	246,000
International Nickel, pfd., c, n	Canada	1.75 Q	158,959
Teck-Hughes, g	Canada	0.15 Q	713,574
Total			$17,185,394

c, copper; z, zinc; l, lead; s, silver; g, gold; n, nickel; Q, quarterly; MX, monthly and extra.

Domestic Lead Daily Rate Lower in July

Although domestic lead output increased to 51,538 in July from 50,721 tons in June, the daily rate dropped from 1,691 to 1,662, according to figures released by the American Bureau of Metal Statistics. Stocks of refined increased 7,379 tons in July. Total production of lead in the United States from domestic and foreign ore, including secondary metal handled by primary smelters, registered a slight increase at 56,204, over 55,686 tons in June, but is still well below the production of 59,170 tons in May. Details, in tons of 2,000 lb., follow:

U. S. Stocks and Shipments

Production:	June	July
From domestic ore	50,721	51,538
Secondary and foreign	4,965	4,666
Total production	55,686	56,204
Stock at beginning	49,638	55,501
Total supply	105,324	111,705
Stock at end	55,501	62,880
Shipments by difference	49,823	48,825
Shipments reported	50,127	48,816

Production From Domestic Ores

	1929	1930
January	63,165	49,991
February	55,546	54,125
March	61,110	56,552
April	58,040	55,547
May	63,632	52,818
June	58,380	50,721
July	59,155	51,538
Monthly average	59,681	53,042

Industrial Classification of Domestic Shipments

	June, 1930	July, 1930
Cable	15,609	16,842
Ammunition	2,971	2,068
Tin foil	2,192	1,973
Batteries	5,407	2,919
Brass-Making	138	213
Sundries	2,733	3,438
Jobbers	266	1,328
Unclassified	20,811	20,035
Total	50,127	48,816

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North Lily-Knight Merger

Stockholders of North Lily Mining, controlled by International Smelting, Anaconda Copper's Utah subsidiary, have ratified the proposed arrangement with the Knight Investment Company. North Lily, which already operates a silver-lead-gold property in the Tintic district, thus acquires control over 4,000 acres of mineral land in the East Tintic district, including the Twentieth Century, Empire Mines, Big Hill, and other groups. North Lily-Knight has been formed to develop these properties, with 51 per cent of the stock held by North Lily Mining in exchange for $300,000 worth of development work over a period of three years. North Lily has also loaned Knight Investment $125,000, secured by 400,000 shares of North Lily-Knight stock held by the latter company.

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Nickel Earnings Lower

Net profit of International Nickel in the second quarter of 1930 was $3,267,730, compared with $4,616,144 in the first quarter of the year. The total profit for the first half of the year was $7,883,874, compared with $11,238,176 in the first half of 1929. Inactivity of the market for nickel was the chief reason for the decline in profits. Current assets of the company on June 30, 1930, were $31,195,620, compared with current liabilities of $7,624,797.

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FREEPORT TEXAS, sulphur producer operating in Texas, reports net income of $1,832,160 for the six months ended May 31, 1930, compared with $1,873,519 in the corresponding period in 1929.

Decrease in Daily Rate of World Copper Output

Figures for world copper production in July, released by the American Bureau of Metal Statistics, show that although the month's total has decreased only slightly, the daily rate is at its lowest level since January, 1928. This would seem to indicate that the price level is beginning to influence output. The total for July was 143,615, compared with 145,797 for June, and the daily rate for July was 4,633, compared with 4,860 in June, and 4,642 for the year 1927. Details, in short tons, follow:

	June	July
United States	69,155	67,638
Mexico	5,371	4,968
Canada	11,005	11,820
Chile and Peru	23,043	23,328
Japan	7,895	7,365
Australia	2,487	496
Germany	4,141	...
Other Europe (a)	11,400	16,000
Elsewhere (a)	11,300	12,000
World's total	145,797	143,615

(a) Partly estimated.

	Monthly Production	Daily Rate
January	155,848	5,027
February	140,084	5,003
March	148,944	4,805
April	145,595	4,853
May	148,788	4,800
June	145,797	4,860
July	143,615	4,633

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Gold Activity Up in Ontario

The Ontario Department of Mines reports more gold ore milled in July than in any other month so far this year, 324,993 tons, but the bullion value dropped off a little to $2,888,302. Porcupine contributed 208,512 tons, the bullion value of which was $1,467,220, or $7.03 a ton; and Kirkland Lake, 101,917 tons, containing $1,365,743, or $13.40 a ton.

Producing mines were: Porcupine: Hollinger, McIntyre, Vipond, Coniaurum, March, Dome, and Purcupine United. Kirkland Lake: Lake Shore, Teck-Hughes, Wright-Hargreaves, Sylvanite, Kirkland Lake Gold, and Barry-Hollinger. Red Lake: Howey.

Complete Market News and Prices

THE semi-monthly magazine you are now reading carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, minerals, and scrap who require reliable information as soon as it is available, we now provide *Metal and Mineral Markets*, which goes to press at the close of the metal-market week each Wednesday. It is printed at high speed and is in the mails that evening. In compact form, ready for insertion in a ring binder, it is ideal for desk and reference use. It carries the standard *E.&M.J.* quotations used in contracts the world over, recognized as authoritative and dependable. *Metal and Mineral Markets* is priced to subscribers in the United States and its possessions at $2 per annum; to countries in the Americas but outside the United States, $5; elsewhere, $10 yearly: 52 issues. Address *M.&M.M.*, 36th St. and 10th Ave., N.Y.City.

Trend of Metal Prices Irregular as Big Midsummer Demand Quiets Down

New York, Aug. 21, 1930.—Demand has moderated considerably in the last two weeks, following an unusually active metal market this summer, stimulated by low prices. The large forward buying of copper has stopped, but a good demand still exists if it could be satisfied below 11c. Lead buying also has been extremely quiet, but the recent advance in prices has been firmly maintained. Zinc has continued to give ground, getting down to around 4.30c., but meeting speculative buying at that level. Silver has done better, thanks to Chinese buying, and has gone above 36c. Tin is firm but quiet around 30c. Among the minor metals may be noted a somewhat easier tendency in antimony after the recent sharp advance, though the market is largely nominal; and a distinctly weaker tone in the precious-metal group, platinum having sold for as low as $37.

A Little Copper at 10¾c.

The heavy demand for forward copper, stimulated by successive reductions in the price to 11c., delivered, has gradually moderated, until in the last week the demand has not been sufficient to absorb the offerings of those who make a practice of selling their intake or production from week to week. The first break from the 11c. price came on Aug. 13, when a substantial tonnage was sold to a consumer at 10¾c. During the next week, several smaller lots were sold at the same price, but large buyers were not able to find any offerings below 11c. At the even figure, the large producers have continued to sell a little to their regular customers, and where special shapes were involved. The market therefore may be quoted at 10¾@11c., delivered, with only a little demand at the higher figure, and but few offerings at the lower, with indications that this condition may obtain for some little time.

Wire and cable mills continue relatively more active than the brass makers, for the public utilities have seen the opportunity of expanding their physical facilities while the price of copper and other metals is considerably below normal. General industrial activity, on the other hand, continues too low to absorb much of the excessive stocks of copper in the building, automotive, and machinery industries. Production has been cut to accord with consumption, but now consumption must increase to reduce accumulated stocks before a rise in prices can be expected.

Copper exporters continue to quote 11.30c., c.i.f.

Lead Much Quieter

Lead prices are unchanged from two weeks ago, at 5.35c., St. Louis, and 5.50c., New York, the last price being the contract quotation of the American Smelting & Refining Company. The period has been exceptionally quiet, one week being the dullest, in volume of sales, for over two years, and last week not showing much improvement. Sales for shipment in August already have equaled the total for July, with the probability that several thousand tons more will be sold for prompt shipment before the end of the month. About half of expected September requirements has also been booked. Though demand was stimulated, without doubt, by the quarter cent rise in price at the end of July, there has been little speculation in lead, and actual consuming demand is likely to be good in September. No recession in price is expected, and no immediate advance is in prospect. Foreign demand has been good and the London market has been steady at better than £18.

Battery manufacturers continue conspicuous by their absence from the market, but most other consuming lines have been satisfactory.

Galena concentrates in the Joplin market have sold at $65 a ton the last two weeks, 80 per cent basis, with supplies somewhat restricted.

Zinc 4.30@4.40c.

The decline in zinc from the recent high of 4⅞c. has continued, but around 4.30c. producers and traders entered the market, and bought enough, from the few that were willing to sell, to cause a temporary advance to 4.40c. A fair tonnage of forward metal was sold at that price, but in the last few days demand has moderated, and the price has sunk back to 4.30c. with but little interest in either selling or buying circles. Stocks of zinc have shown little change recently, indicating that production is well in accord with consumption, but, as in copper, stocks are more than adequate, which prevents any upward movement in the price. Most of the supplies are in strong hands, however.

The market for blende concentrates in Joplin continues unchanged at $32, 60 per cent basis, for Premium and Prime Western grade.

Tin Practically Unchanged

Restriction of tin production seems to be in process of being successfully accomplished, but this bullish factor has done no more than prevent any further decline in prices. American consumption has been disappointing. Prompt Straits continues in a narrow price range around 30c., with buying very moderate, chiefly for fairly near-by positions. Forward tin commands a premium of about ⅛c. a month.

Silver Stronger

Silver producers have been somewhat encouraged by the higher prices recently obtaining, but should not look for any marked advance above current levels of about 36c. Chinese buying, which is involved in the problem of foreign exchange, has improved, and India has operated on the buying side as well. Misleading reports continue to be published that silver is being dumped in this country; the United States is still exporting a considerable part of its production, and no silver is being imported from the Far East.

Other Metals

Quotations cover wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., delivered, Alcoa commercial and mill ingot, 99 and 98 per cent, 23.30c.; Alcoa No. 12 alloy, 22c.; metallurgical ingot, 94 per cent plus, 21.30c. Outside market, 99 per cent, 23.30c.; 98@99 per cent, 22.90c. Market continues quiet. London unchanged at £95, less 2 per cent, per long ton, for 98 per cent ingots and bars.

ANTIMONY—Per lb., duty paid, Chinese, spot, 7⅞c.; futures, 7⅛@7¼c. Market again very quiet after a mild buying wave on the rise. Prices on forward shipments only nominal on account of uncertainty of Chinese shipments. Cookson's "C" grade, spot, 12⅞c. "C.M.C." grade, 99.9 per cent, spot, 10¾c.

BISMUTH—Per lb., in ton lots, $1. London, 4s.

CADMIUM—Per lb., 70c. London, 3s. 3d.

CHROMIUM—Per lb., 97@98 per cent grade, 85@90c.

COBALT—Per lb., delivered: Metal imported from Belgium in the form of ronndelles, 97@99 per cent, spot, $2.50, Discounts on contracts. Quiet. London, spot, 10s.

IRIDIUM—Per. oz., $220@$250 for 98 @99 per cent sponge and powder. London, £51½.

MAGNESIUM—Per lb., 12-lb. ingots (4x4x16 in.), 99½ per cent, 65c.@$1, depending on quantity; 2½- or 3-lb. sticks (1⅜ in.), 70c.@$1.05, depending on quantity. London, 2s. 9d.@3s. for 99 per cent ingots or sticks.

MANGANESE—Per lb. contained manganese, 95@97 per cent, 42c.

MOLYBDENUM—Per lb., in 50- to 100-lb. lots, 99 per cent powder, $9.50; 97 per cent, $6.50. (Usually sold as calcium molybdate or ferromolybdenum, which see.)

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent), for single lots of spot metal. Contracts, 30@33c. London, per long ton, £170@£175.

Daily Prices of Metals

Aug.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
7	10.775	30.25	5.50	5.35	4.35 @4.50
8	10.775	30.20	5.50	5.35	4.35 @4.50
9	10.775	30.20	5.50	5.35	4.40
11	10.775	30.25	5.50	5.35	4.275@4.35
12	10.775	30.00	5.50	5.35	4.275@4.325
13	10.525	29.875	5.50	5.35	4.275@4.325
Av'ge	10.733	30.129	5.500	5.350	4.360
14	10.525@10.775	29.90	5.50	5.35	4.30@4.325
15	10.525@10.775	29.95	5.50	5.35	4.375@4.40
16	10.525@10.775	29.95	5.50	5.35	4.375@4.40
18	10.525@10.775	30.10	5.50	5.35	4.35@4.40
19	10.525@10.775	30.10	5.50	5.35	4.325
20	10.525@10.775	30.00	5.50	5.35	4.30
Av'ge	10.650	30.000	5.500	5.350	4.348

Average prices for calendar week ended August 9, 1930, are: Copper, 10.775c.; Straits tin, 30.200c.; New York lead, 5.500c.; St. Louis lead, 5.350c.; zinc, 4.448c.; and silver, 34.500c.

Average prices for calendar week ended August 16, 1930, are: Copper, 10.671c.; Straits tin, 29.988c.; New York lead, 5.500c.; St. Louis lead, 5.350c.; zinc, 4.333c.; and silver, 35.271c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East and Middle West is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Aug.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
7	4.86 7/8	34 1/2	15 15/16	84s11 7/8d	14	4.86 13/16	35 5/8	16 5/16	85s
8	4.86 13/16	34 1/2	15 15/16	84s11 7/8d	15	4.86 13/16	35 1/4	16 3/16	85s
9	4.86 7/8	34 3/4	16	.....	16	4.87	35 3/8	16 1/2	.....
11	4.86 7/8	35 1/8	16 3/16	84s11 7/8d	18	4.86 7/8	36 1/4	16 13/16	85s
12	4.86 7/8	35 1/4	16 3/16	85s 0 1/8d	19	4.86 13/16	36	16 13/16	84s11 3/8d
13	4.86 13/16	35	16 1/8	85s 0 1/8d	20	4.86 3/4	36 1/4	16 11/16	85s

Average of week ended August 13: Silver, 34.854c.; Sterling Exchange, $4.86854.
Average of week ended August 20: Silver, 35.792c.; Sterling Exchange, $4.86844.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-eighth of 1 per cent premium.

London

Aug.	Copper Standard		Electrolytic	Tin		Lead		Zinc	
	Spot	3 M		Spot	3M	Spot	3M	Spot	3M
7	48 3/16	48 3/16	51	136 1/2	138 3/8	18 3/8	18 5/16	16 1/2	16 5/8
8	48 5/16	48 5/16	51	136 3/8	138 1/4	18 3/8	18 5/16	16 1/16	16 9/16
11	48	47 15/16	51	136 1/2	138	18 1/4	18 1/4	16 1/2	16 5/8
12	47 13/16	47 15/16	51	135 3/4	137 1/2	18 3/16	18 3/16	16	16 9/16
13	47 1/2	47 9/16	51	134 5/8	136 1/2	18 1/16	18 1/16	15 7/8	16 5/8
14	47 5/16	47 3/8	51	134 1/4	136 1/2	18 1/4	18 3/16	15 13/16	16 1/4
15	47 1/4	47 1/4	50 1/2	134 1/8	135 7/8	18 3/16	18 1/8	15 7/8	16 5/16
18	47 3/8	47 7/16	50 1/2	134 1/2	136 1/4	18 5/16	18 3/16	16 1/16	16 9/16
19	47 1/4	47 1/4	50 1/2	135	136 1/2	18 3/8	18 3/16	16 1/8	16 5/8
20	47 3/16	47 5/16	50 1/2	134 3/4	136 5/8	18 1/4	18 1/8	16 1/8	16 5/8

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

OSMIUM—Per oz., $60@$70. London, £15½.

PALLADIUM—Per oz., $20@$23. London, £4½.

PLATINUM—Per oz., official price of leading interest, $43. Cash transactions between dealers and refiners at several dollars less. Market is weaker, and all of the precious metals are extremely dull. London, per oz., £8.

QUICKSILVER—Per 76-lb. flask, $116, delivered, though asking price about $120 for small lots. London slow at £22 5/8.

RADIUM—Per mg. radium content, $50 in lots of 4 grams or more, to $65 for 1 gram; smaller quantities, $70.

RHODIUM—Per oz., $45@$55. London, £11.

RUTHENIUM — Per oz., $40@$42. London, £9½.

SELENIUM—Per lb., $1.80@$2, depending on quantity, for black, powdered, 99.5 per cent pure. London, 7s. 8d.

SILICON—Per lb., 97 per cent, 15@17c.

TANTALUM—Per kilo, $128 for C.P. sheet. Slow. London, per lb., £40.

TELLURIUM—Per lb., $2. London, 12s. 6d.

THALLIUM—Per lb., $12.50@$15.

TITANIUM—Per lb. in 50- to 100-lb. lots, 75 per cent, $5.

TUNGSTEN—Per lb. contained tungsten, 98 per cent, powdered, $1.55@$1.60. Slow.

VANADIUM—Per gram, 95 per cent, $1.25. Per lb. in 100- to 500-lb. lots, 90 per cent, $4.50.

Metallic Ores

Prices in tons of 2,000 lb., or in "units" of 20 lb., unless otherwise stated.

ANTIMONY ORE—No sales reported. London, per long ton unit, 3s. 6d.@4s. for 60 per cent sulphide ore.

BERYLLIUM ORE—Per unit of BeO, minimum 11 per cent BeO, $4@$5, f.o.b. mines.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian ores, $19.50 for 46@48 per cent Cr_2O_3 ore, and $24 for 50@51 per cent ore. London, £4⅛ for 48 per cent Rhodesian, and £4¼@£5¼ for Indian and New Caledonian.

IRON ORE—Per long ton, Lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 10c.

Foreign ores, alongside docks Atlantic ports, cargo lots, cents per unit:

North African and Swedish, low-phosphorus, 10c.

Spanish and North African basic, 50@60 per cent, 9@9½c.

Swedish foundry or basic, 65@68 per cent, 10c.

Newfoundland foundry, 55 per cent iron, 9c.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, cargo lots, exclusive of duty: Brazilian, 46@48 per cent Mn, 25c.; Chilean, 47 per cent minimum, 30½c.; Indian, 48@50 per cent, 27@28c.; Caucasian, 52@55 per cent, 27@28c.; South African, 52@54 per cent, 27@28c., nominal. Inactive.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, minimum 80 per cent MnO_2, Brazilian or Cuban, $60. Javan or Caucasian, 85 per cent minimum, $60. Domestic, 70 to 72 per cent, $60, f.o.b. mines.

MOLYBDENUM ORE—Per lb. of contained MoS_2, United States market entirely nominal at 50@55c. London, per long ton unit, nominal at 32s. 6d. for 80@85 per cent concentrate.

TANTALUM ORE—Per lb. Ta_2O_5, $1.40 for 60 per cent ore. Per lb., f.o.b. *New Mexico* mines, crude ore with minimum 40 per cent Ta_2O_5, 40c. Good demand.

TIN ORE—No market in United States. London, returning charge on 60 per cent Bolivian, £10 per long ton; on 70 per cent Nigerian, £5§.

TITANIUM ORE — Per gross ton, ilmenite, 45@52 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$12, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c. in carload lots.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Chinese wolframite, $11.50, duty paid. Bolivian scheelite, $13@$13.50, and domestic, $14; both nominal.

VANADIUM ORE—Per lb. V_2O_5 contained, 27c., f.o.b. shipping point. Slow.

ZIRCON ORE—Per ton, 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots. Crude granular zircon, $70, f.o.b. Suspension Bridge, N. Y.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

Tons of 2,000 lb. unless otherwise noted.

[1]AMBLYGONITE — Per ton, f.o.b. mines, 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton, f.o.b. Quebec mines, tax and bags included: Crude No. 1, $475@$575; crude No. 2, $325@$375; spinning fibers, $150@$175; magnesia and compressed sheet fibers, $100@$135; various grades shingle stock, $50@$85; various grades paper stock, $35@$40; cement stock, $15@$25; floats, $12@$15. Market weak and prices subject to shading.

Per ton c.i.f. New York: Rhodesian crude No. 1, $350; No. 2, $275.

BARIUM CARBONATE (Witherite)—Per ton: 90 per cent, 200 mesh, $47; 100 mesh, $44.

BARYTES—F.o.b. mines, bags extra:

Georgia: Barytes ore, crude, $6.50 per long ton; shipments are about half of normal.

Missouri: Per ton, water ground and floated, bleached, $23, car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7; over 1 per cent iron, and 93 per cent $BaSO_4$, $6.50, f.o.b. mines. Market fair.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7@$8.25, f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.50@$8, f.o.b. *Arkansas* mines. Pulverized and dried, 56 to 59 per cent Al_2O_3, 8 to 12 per cent SiO_2, $12@$12.25, f.o.b. *Arkansas* mines; abrasive grade, crushed and calcined, 78 to 84 per cent, Al_2O_3, $15@$17.50, f.o.b. *Arkansas* mines.

Per metric ton, foreign, c.i.f. Atlantic ports: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50; one dealer reports $7 for material running 52@54 per cent alumina and 1.50 per cent silica; market fair. Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 4 per cent SiO_2, $6@$8; 56 per cent Al_2O_3, 1.50 per cent SiO_2, $7; 58 per cent Al_2O_3, 3@4 per cent SiO_2, $6.50.

BENTONITE—Per ton, f.o.b. Wyoming mines, dried and crushed, in bulk, $8; in bags, $10. F.o.b. Chicago, selected air-floated, $25. Market fair.

BORAX—Per ton, carload lots, in bags, crystals, $56; granulated, $50; powdered, $57.50; f.o.b. shipping point.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHINA CLAY (KAOLIN) — Per ton: F.o.b. *South Carolina* mines, crude lump, No. 1, $5@$6; pulverized, $8@$12.

Florida, washed, $12@$12.50 in bulk. Fair demand.

Imported English, f.o.b. American ports; lump, $14@$20 in bulk. Market fair.

EMERY—Per ton, f.o.b. *New York*, domestic crude ore, $10; foreign, $25@$30. Market normal. F.o.b. *Pennsylvania*, in 350-lb. kegs, Turkish, Khasia, and Naxos emery, 6½c. per lb.; American, 3½c. Quiet.

FELDSPAR—Per ton, ground: Canada, $22; New England, $30; Southern, $25; Trenton, $23.50; Western, $24.

Virginia, No. 1, 325 mesh, $18; 200 mesh, $15@$16; 160 mesh, $14; No. 1 glassmakers', $11. Market fair to good.

FLUORSPAR—Per ton, f.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Market quiet owing to low operations of the steel melters.

FULLER'S EARTH — Per ton, f.o.b. *Colorado*, $18, various finenesses to minus 90 mesh.

GARNET—Per ton, f.o.b. *New Hampshire* mines: crude or mill run, $45; unwashed grades, $85; washed, $125. Average demand for crude but other grades very quiet.

New York: Adirondack garnet, $85. Very quiet.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE—Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50. Market normal.

GRAPHITE—Per lb., f.o.b. *New York:*

Ceylon lump, 7½@8½c.; chip, 6@7c.; dust, 2½@4½c.; Madagascar flake, 6@8c. Market quiet and easier.

No. 1 flake, 8@16c.; fine ground, 5c. upward; amorphous, 3c. upward.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20. Market improving, with good fall trade expected.

GYPSUM—Per ton, f.o.b. mill, *Iowa*, $2.50; *Kansas*, $1.40; *Ohio* and *New York*, $3. Ground, *Ohio*, $4; *Iowa*, $6. Agricultural, $6@$7. Calcined $6@$9.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton, $50@$60 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$1.75.

Agricultural, 75c. up to $3.50 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE—Per ton, f.o.b. *California* steel mill points: dead-burned, $29. Market about 60 per cent of normal. *Washington:* Dead-burned grain magnesite, $22. Market below average.

MICA—Per ton, f.o.b. *New Mexico*, scrap, white, $21; off color, $18. Punch, white, for disks, per lb., 10c.; for washers, 8c. Good demand.

F.o.b. *New Hampshire*, roofing mica, $23; Christmas snow, $34; 40 mesh white, $40; 60 mesh, $48; 100 mesh, $60; 200 mesh, $75. Clean dry mixed bench and mine scrap, $13. Orders for use in electrical instruments showing slight increase. Ground mica moving fairly well with very small stock on hand.

MINERAL BLACK—(Graphitic shale) —Per ton, 325 mesh, 75 per cent carbon, $22.50, f.o.b. *Virginia*.

MONAZITE—Per ton, minimum 6 per cent ThO_2, $60.

[1]Price furnished by Foote Mineral Company, Philadelphia.

OCHER—Per ton, f.o.b. *Georgia* mines: $17.50 in sacks; $20 barrels; second grade, $10. Moderate demand. Buff clay, 98 per cent through 325 mesh, $18.

F.o.b. *Virginia*, dark yellow, 300 mesh, 60 per cent ferric oxide, in jute bags, $19.50.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent, $6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10. Firm.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent $4. Quiet.

Tennessee, ground, 80 per cent through 300 mesh, 33 per cent P_2O_5, $11.80 per ton.

POTASH—Per ton, contracts:

	Bags	Bulk
Muriate of potash, 80@85 per cent, basis 80 per cent	$37.15	$35.55
Sulphate of potash, 90@95 per cent, basis 90 per cent	48.25	46.65
Sulphate of potash-magnesia, 48@53 per cent, basis 48 per cent	27.80	26.20
Manure salt, 30 per cent	22.15	19.15
Manure salt, 20 per cent	15.65	12.65
Kainit, 14 per cent	12.70	9.70

Prices are delivered to Atlantic ports. Discounts up to 6 per cent for early shipment.

PUMICE STONE—Per lb., in barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur, c.i.f. United States ports, guaranteed 48 per cent sulphur, Spanish, 13c.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots, colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. Flawless, for optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton; water ground and floated, in bags, f.o.b. Illinois: 325 mesh, $16@$40 for 92 to 99½ per cent grades. Dry ground, air-floated, 325 mesh, 92@99½ per cent silica, $14@$30. Market steady. Glass sand, f.o.b. producing plant, $1.25@$5 per ton; molding sand, 50c.@$3.50; blast sand, $1.75@$6.

[1]SPODUMENE — Per ton, $50@$60, depending upon lithium content.

[1]STRONTIANITE — Per ton, lump, in carload lots, minimum 88@91 per cent $SrCO_3$, $100.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports. Firm but dull.

TALC—Per ton, carload lots, f.o.b. works, containers included unless otherwise specified:

New Jersey: Soapstone, ground, $10@$12. Market fair.

New York: Double air-floated, short fiber, 200 mesh, $13.75; finer grades up to $16. Market now quiet, though first half of year exceedingly active.

Vermont: 99 per cent through 200 mesh, extra white, bulk basis, $8@$8.50; 97 to 98 per cent through 200 mesh, medium white, $7.50@$8. Packing in paper bags, $1 per ton extra. Demand against contracts continues light and erratic but was somewhat improved in July. Early August demand has been disappointing.

Virginia: 200 mesh, $6.25@$8.50; 325 mesh, $8.75@$11.

TRIPOLI—Per ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $16. Double ground through 110 mesh, rose and cream, $18. Air-floated through 200 mesh, rose and cream, $27.50; mill run, $16. Summer business slow, but August shows marked improvement.

Rolled Metals

COPPER—Per lb., sheets, hot-rolled, 20¾c.; wire, f.o.b. mill, 12¾c.

LEAD SHEETS—Per lb., full rolled, 8¼c. clipped, 8½c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

MUNTZ METAL—Per lb., rods, 17⅛c.; plates, 19⅞c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

NICKEL SILVER—Per lb., sheets, 10 per cent, 25¼@25½c.; 18 per cent, 28¼@29c. Wire and rods, 10 per cent, 28¼c.; 15 per cent, 32½c.; 18 per cent, 36c.

PHOSPHOR BRONZE—Per lb., sheets and rods, 5 per cent tin, 32c.; wire, 5 per cent, 32½c.; 10 per cent, 38c.

ZINC SHEETS—Per lb., 9½c., f.o.b. works; ribbon, 9c.; 7 per cent discount on orders for 18 tons or more.

Alloys

FERROCHROME—Per lb. of contained chromium, 4 to 6 per cent carbon, 11c., delivered, on contracts; spot, 11½c. Containing 2 per cent carbon, 17½c.; 0.06 per cent carbon, 28c.

FERROMANGANESE — Per gross ton furnace; domestic and foreign, 78@82 per cent, $94@$99, contracts, depending on quantity. Spiegeleisen, 19@21 per cent, $33 for spot carloads.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.15.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50, f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, delivered, 50 per cent, $83.50; 75 per cent, $130; 14@16 per cent, $39, f.o.b. Niagara Falls, N. Y. Spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton, $160, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.10 f.o.b. works.

FERROVANADIUM—Per lb. of V contained, delivered, $3.15@$3.50.

SILICOMANGANESE — Per long ton, carload contracts, delivered, $135 for maximum 2½ per cent carbon; $145 for maximum 1 per cent carbon.

SILICON ZIRCONIUM—Per lb., 47@52 per cent Si, 35@40 per cent Zr, 18@21c.

ZIRCONIUM FERROSILICON—Per gross ton, 12@15 per cent Zr, 39@43 per cent Si, $103.50@$108.50.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. Demand has recently been very good, especially from insecticide makers. London, per long ton, £15¾ for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 95c.

COBALT OXIDE—Per lb., black, 70@71 per cent contained Co, $2.10. London, 8s. for black; 8s. 10d. for gray.

COPPER SULPHATE (Blue Vitriol)—Per lb., in car lots, 4¼c. for either large or small crystals.

GERMANIUM DIOXIDE—Per gram, in 200- to 300-gram lots, $3.50.

SODIUM NITRATE—Per 100 lb.; crude natural, in bags ex vessel, Atlantic ports, $1.99. This is a provisional price, the world-wide nitrate combine not yet being completely organized.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $17@$19.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6¼c.; French red seal, in bags, 9⅜c.

Refractories

CHROME BRICK—Per ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M., first quality, $43, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE — Brick, per ton, f.o.b. works, 9-in. straights, $65. Dead-burned grain, $40, f.o.b. Chester, Pa., or Baltimore.

SILICA BRICK—Per M., *Pennsylvania*, $43; *Alabama*, $50@$51; *Illinois* and *Indiana*, $52.

ZIRKITE—Per lb., powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces: Bessemer, $18.50; basic and No. 2 foundry, $18.

STEEL—Per gross ton, base prices, Pittsburgh, billets and slabs, $31; plates and structural shapes per 100 lb., $1.65@$1.70; soft steel bars, $1.65@$1.75.

COKE—Per gross ton, Connellsville furnace, $2.50. Connellsville foundry, $3.50@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $5.50; Buffalo and Detroit, $8@$8.50. Lower prices on byproduct coke.

[1]Price furnished by Foote Mineral Company, Philadelphia.